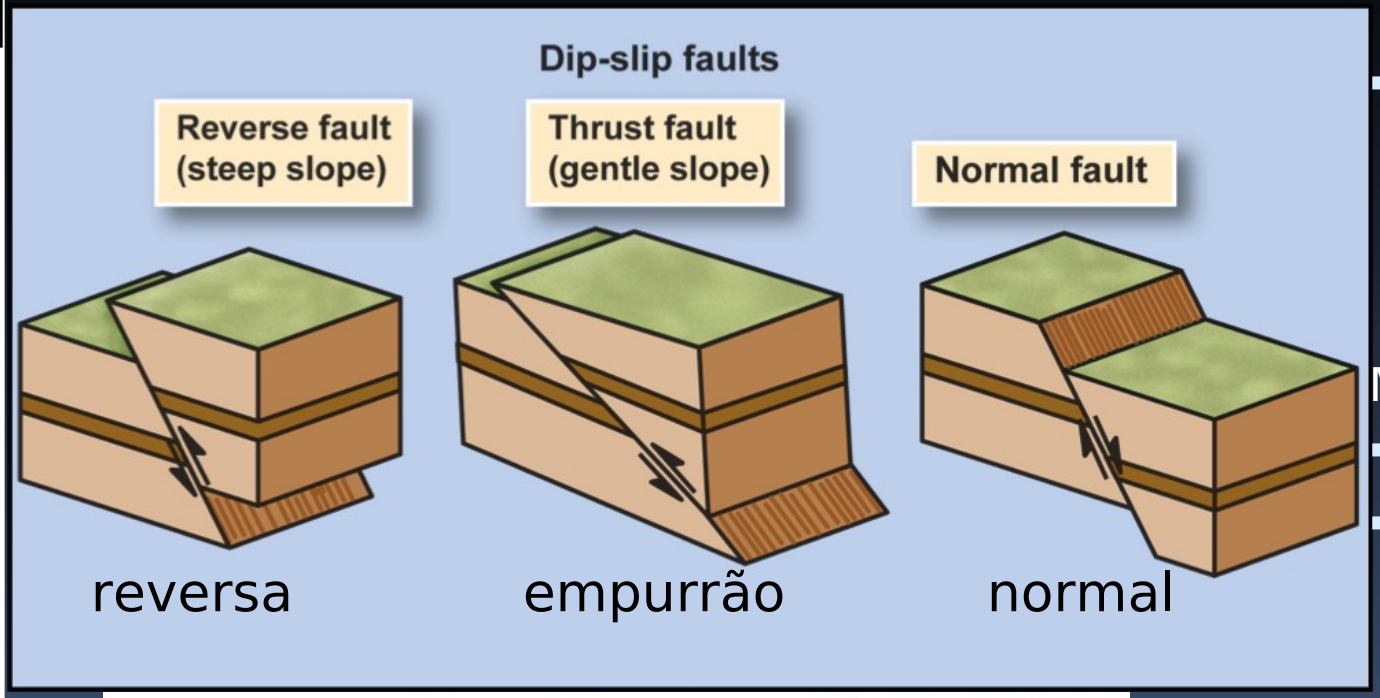
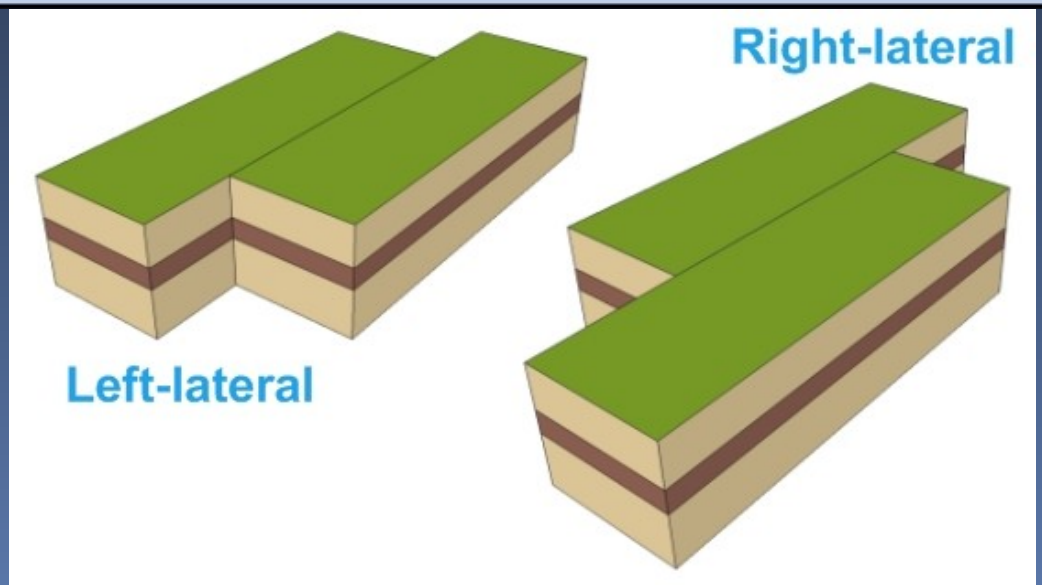
Falhas



- *Dip-lip*: movimento paralelo ao mergulho do plano de falha

Movimento da capa

- *Up-dip* : reversa
- *Down –dip*: normal

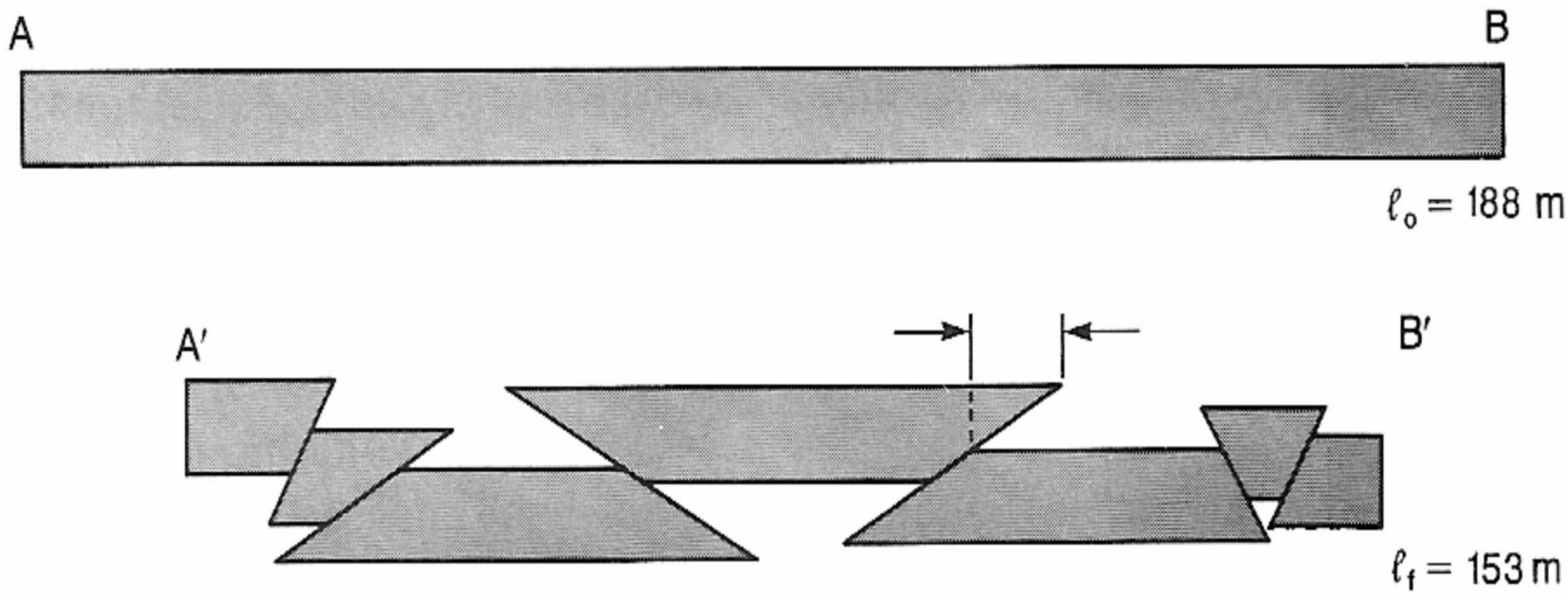


- *Strike-slip*: movimento paralelo a direção do plano de falha

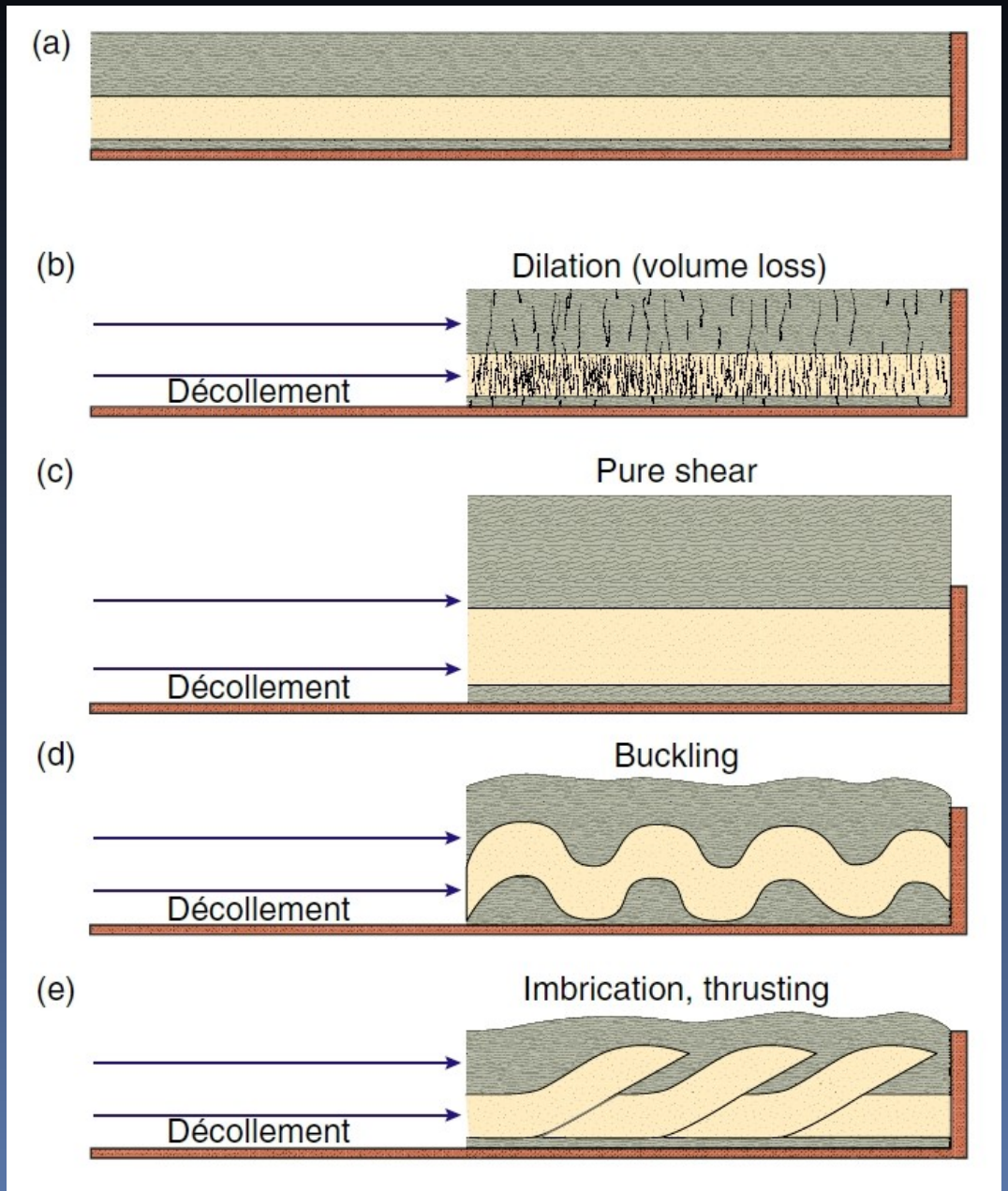
Falhas Reversas (*reverse faults*)

- Reversas → mergulho > 30º
- Reversas de alto ângulo → mergulho > 45º
- Reversas de baixo ângulo → mergulho < 45º
- falhas de empurrão (*thrust faults*) → 10º < mergulho < 30º (para alguns, referem-se a falhas com mais de 5 km de rejeito)
- napes (*nappes*) → pacotes de rochas alóctones sobre falhas de empurrão com mergulho muito baixo

Ambiente compressivo – deformação por encurtamento



Ambiente compressivo – deformação por encurtamento na direção do eixo de compressão



Estilolitos (compensação do encurtamento dissolução e perda de volume)

Cisalhamento puro → camadas mantendo a orientação (compensação do encurtamento por estiramento vertical)

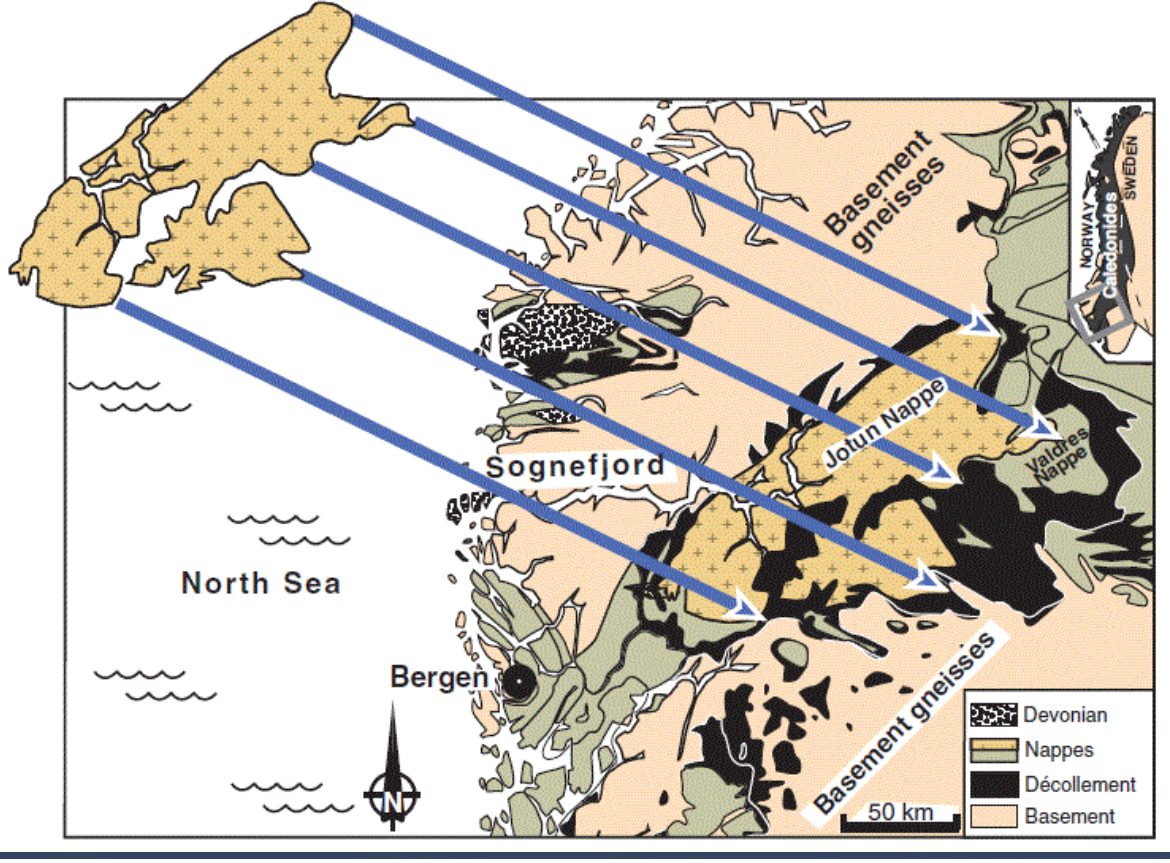
Dobramento (compensação do encurtamento por estiramento vertical)

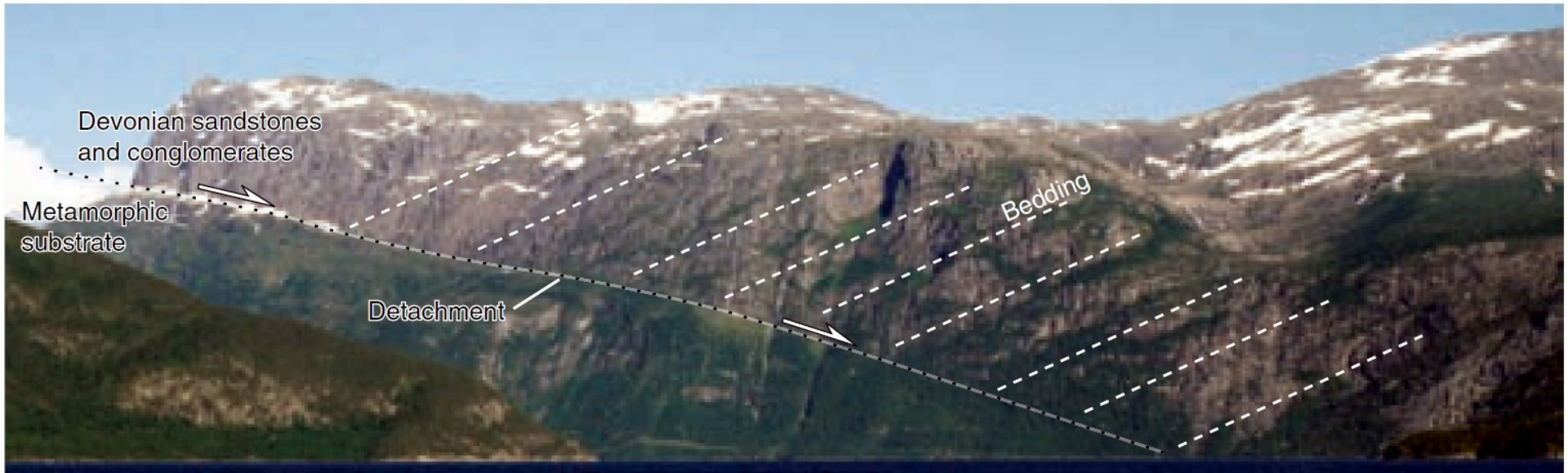
Falhamento (compensação do encurtamento por estiramento vertical)

Detachment x Décollement

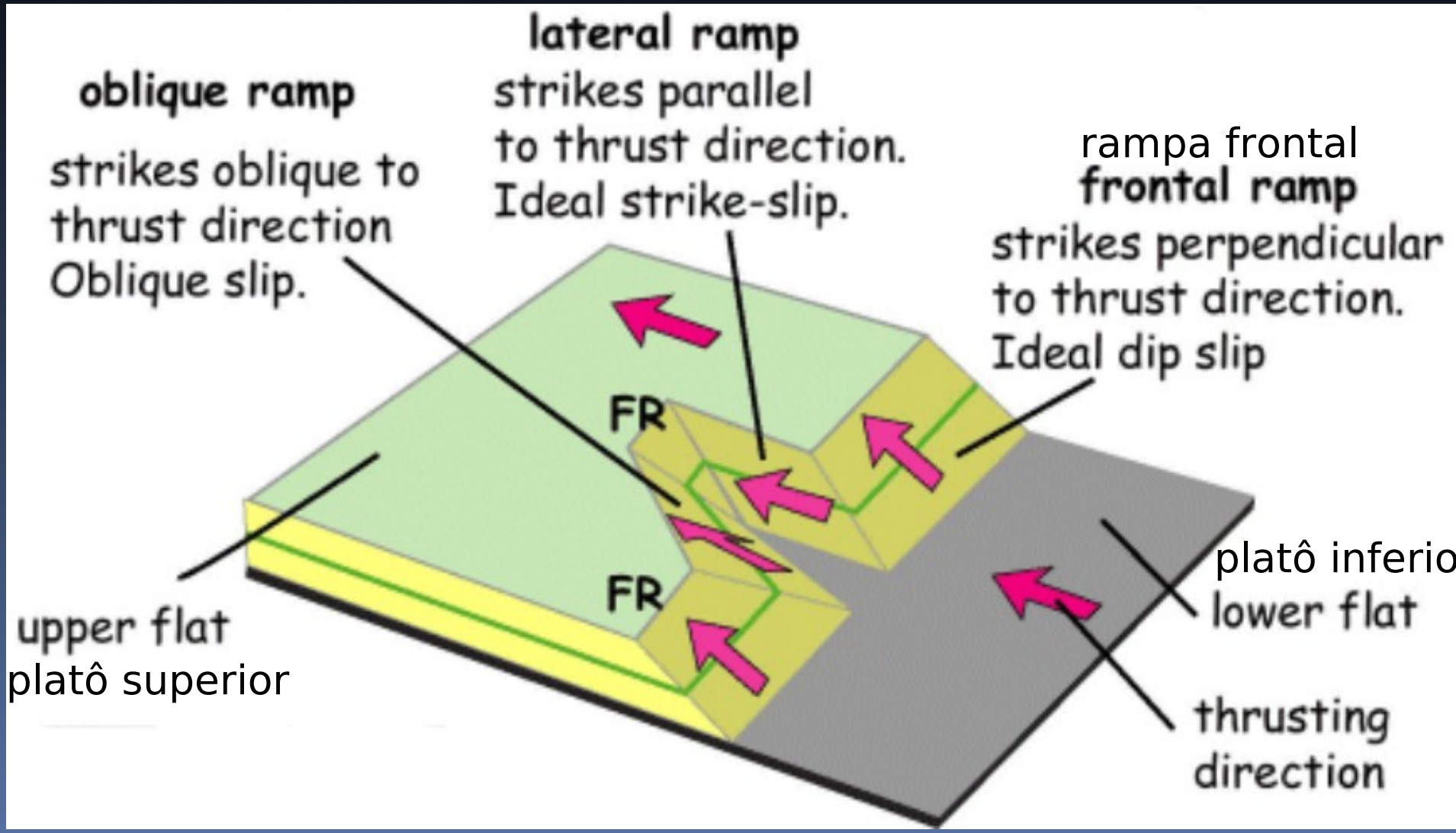
Décollement – falhas de baixo ângulo com dimensão de bacia ou crustal, sobre as quais se nucleiam outras falhas. Utilizado para falhas de empurrão – ambiente compressivo.

Detachment – falhas de baixo ângulo sobre as quais se nucleiam outras falhas. Mais utilizado para falhas normais – ambiente distensivo. Utilizado para falhas de dimensões variadas e até como sinônimo de falha lístrica.

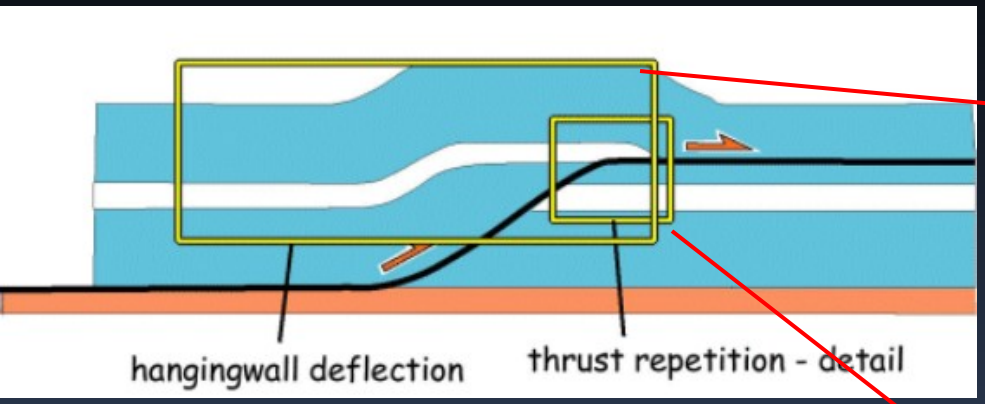




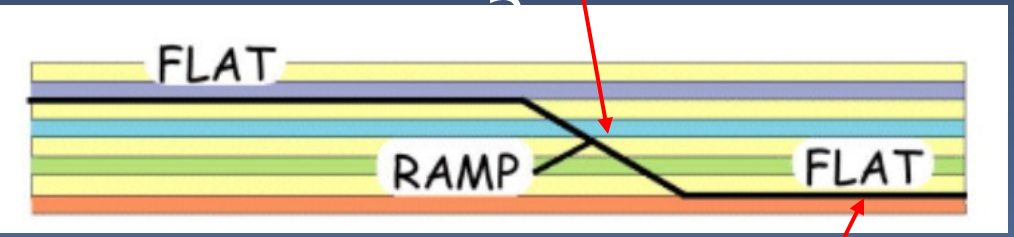
Geometria das falhas de empurrão



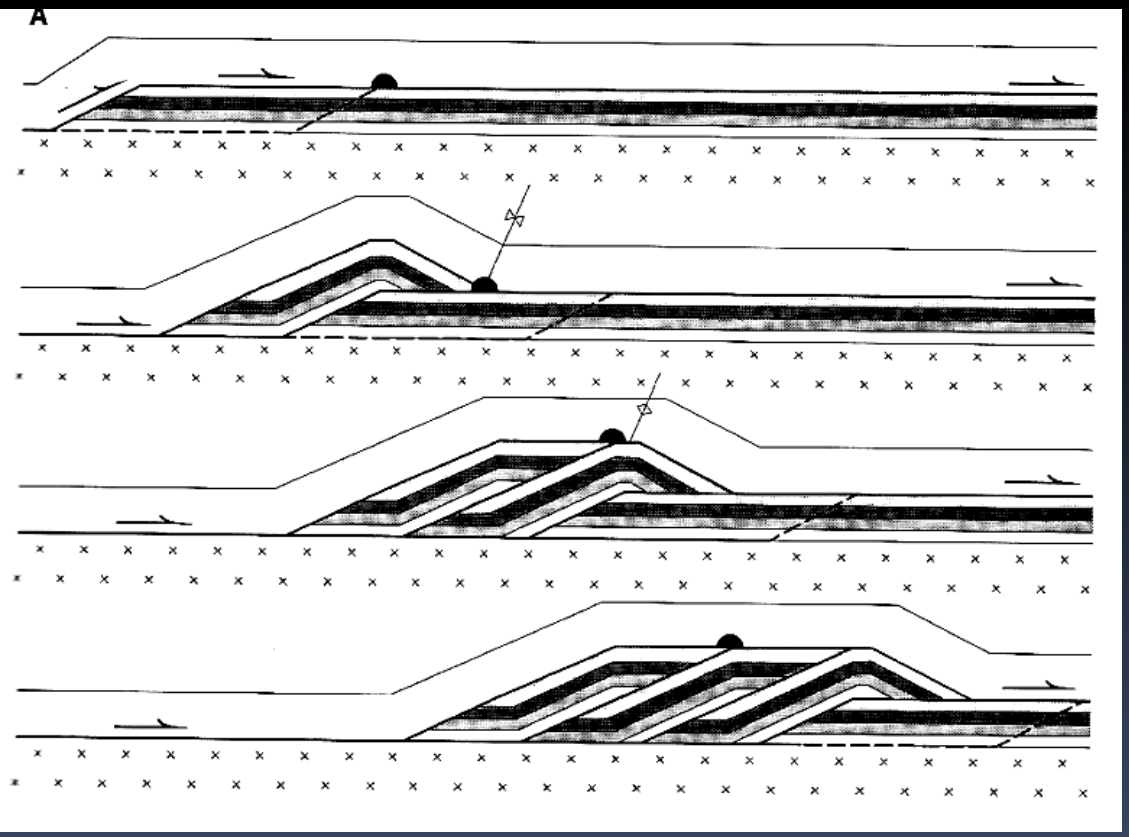
Falhas de empurrão



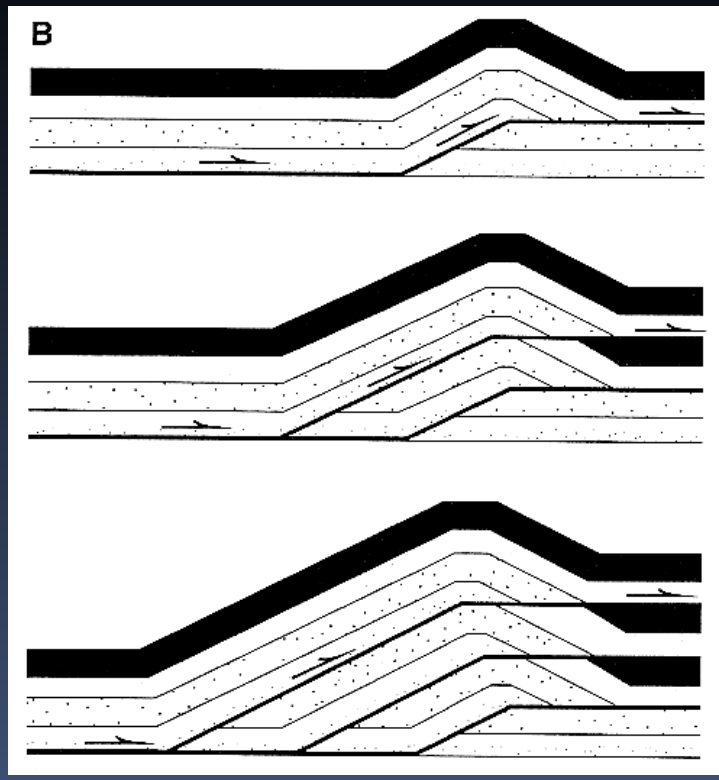
ramp
a



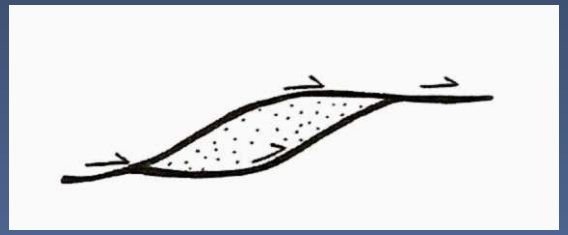
platô



Empurrões em sequência (A) e fora de sequência (B)

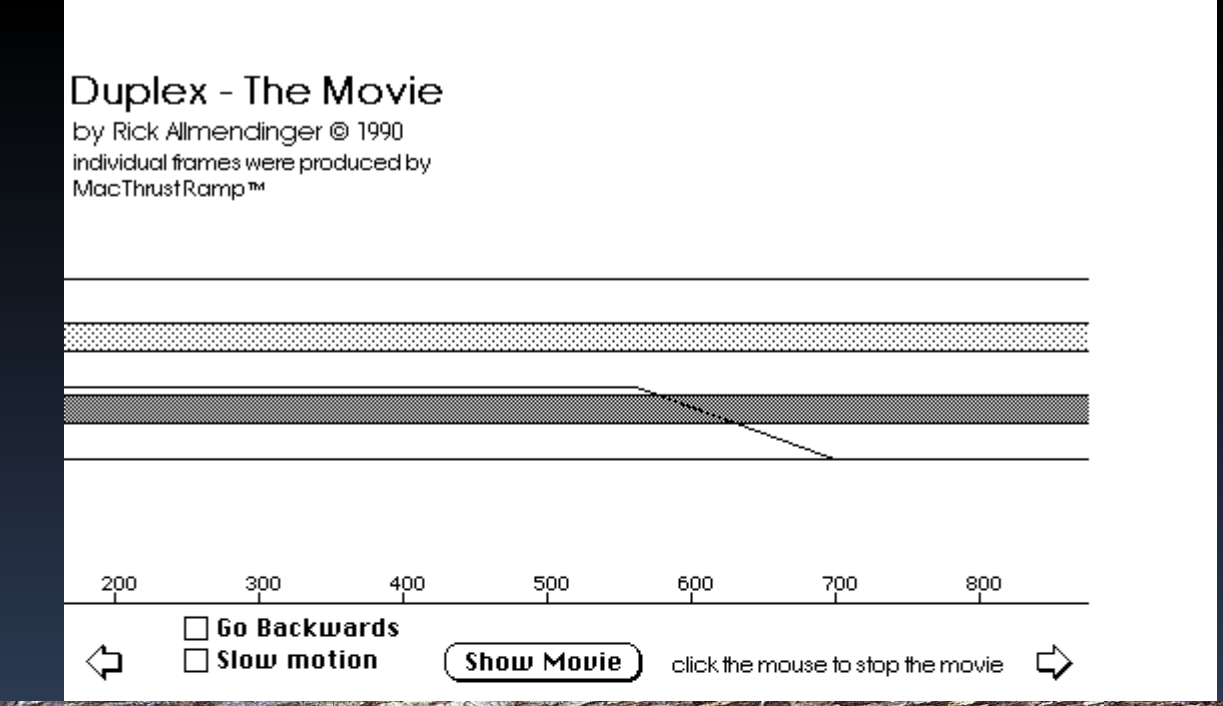


Formação de duplexes

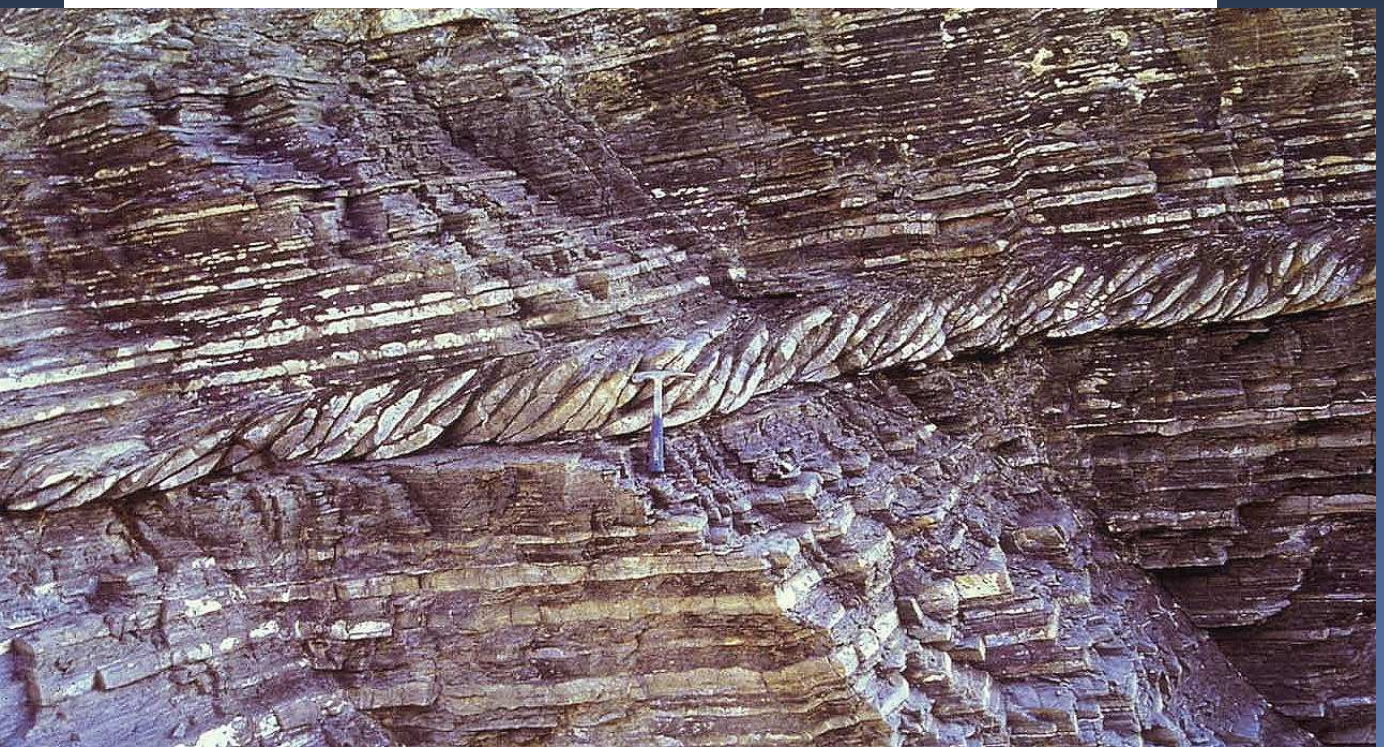


Cavalo – bloco bordejado acima (empurrão superior ou de teto) e abaixo (empurrão

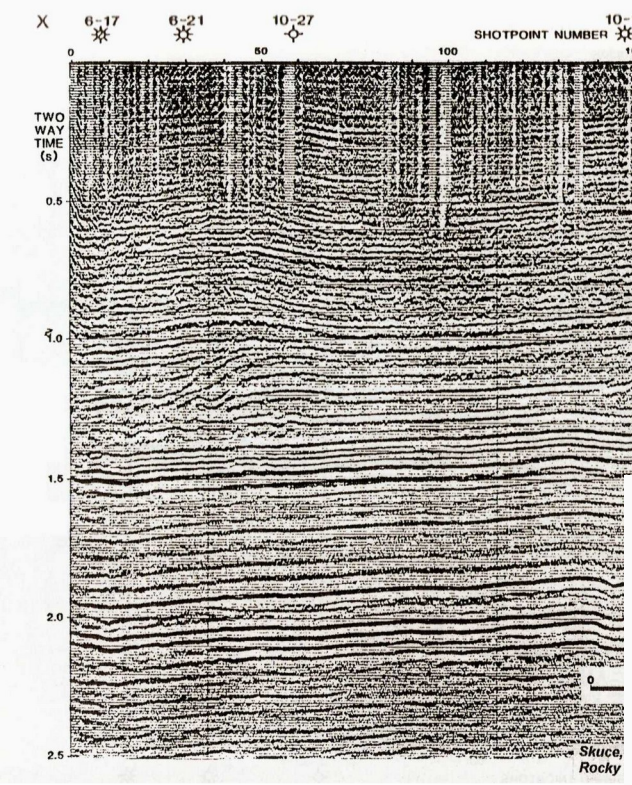
inferior) por falhas reversas

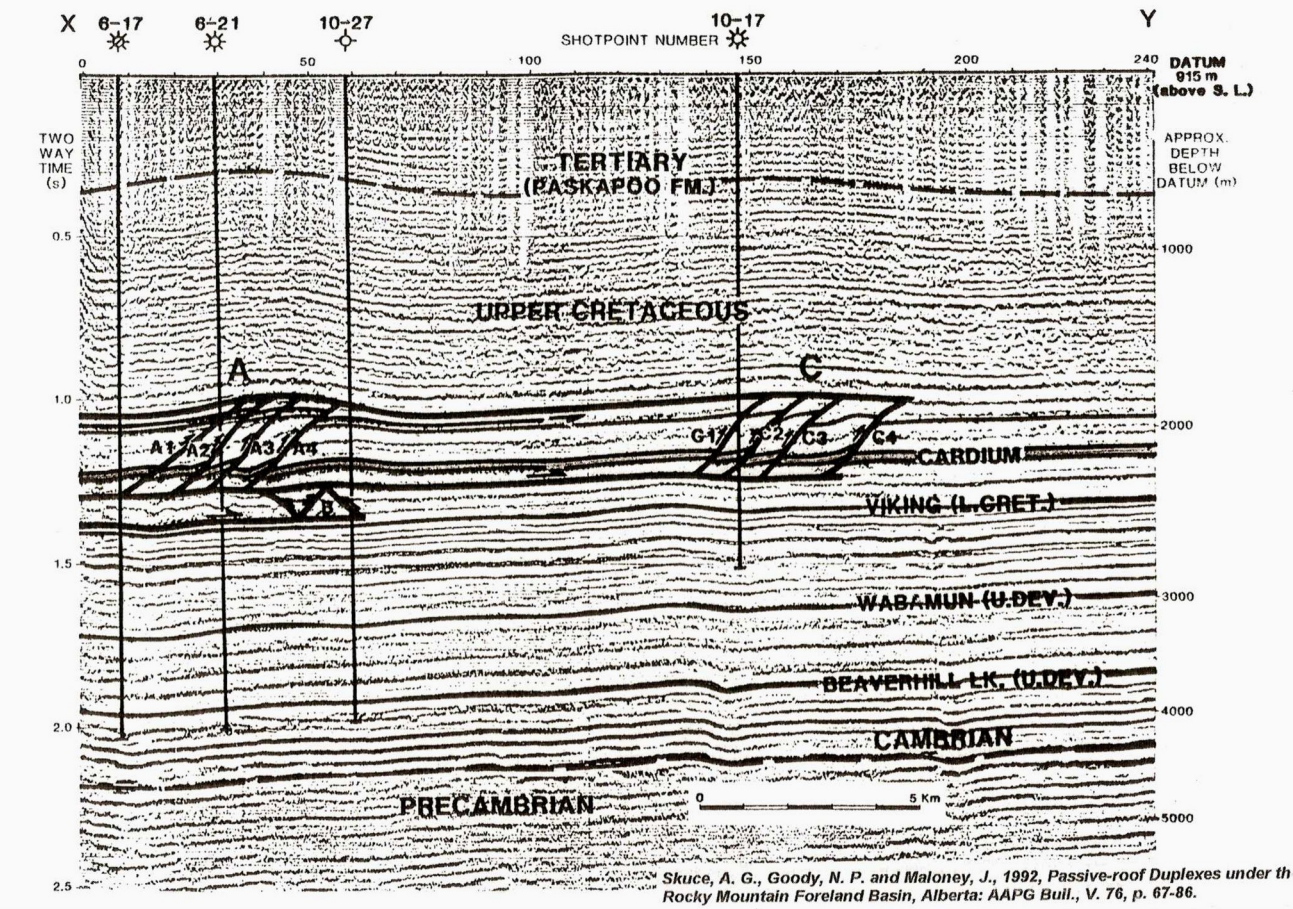


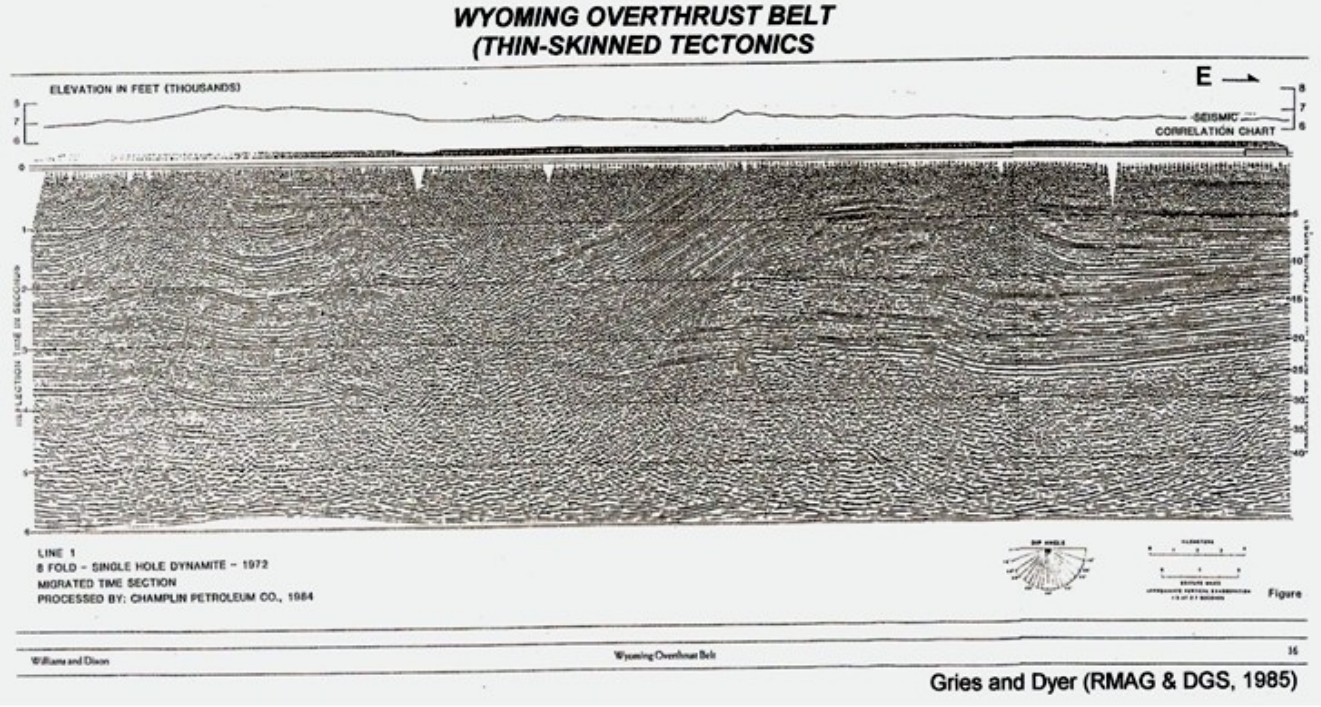
Formação de duplexes



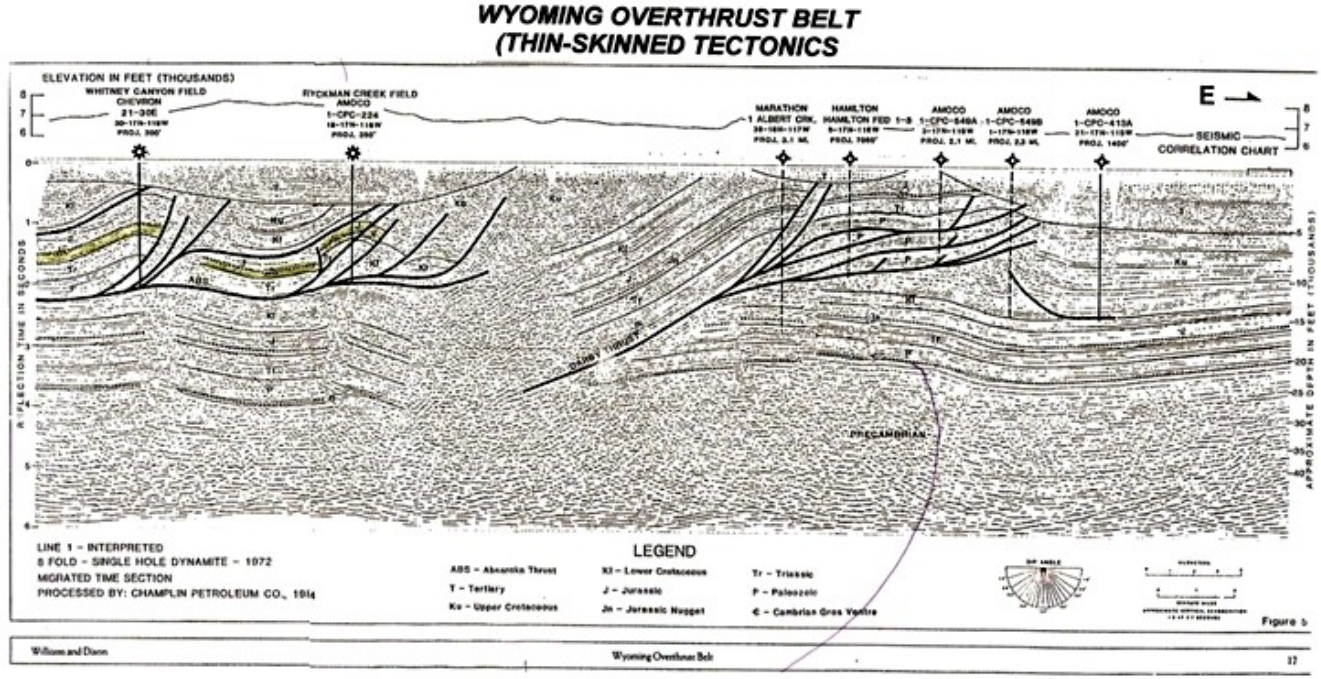
Duplexes sem envolvimento do “teto” – falhas de empurrão limitadas por superfícies de descolamento







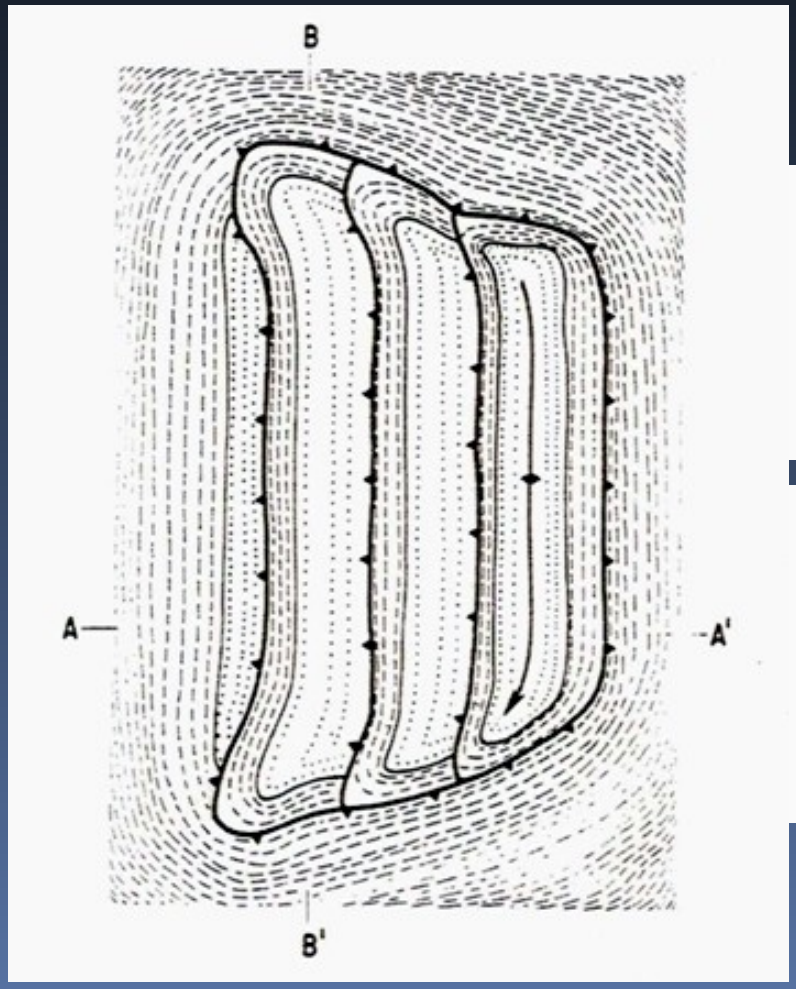
Gries and Dyer (RMAG & DGS, 1985)

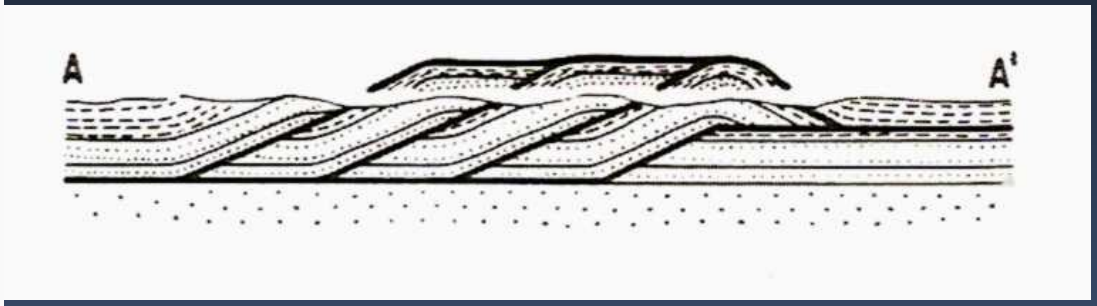


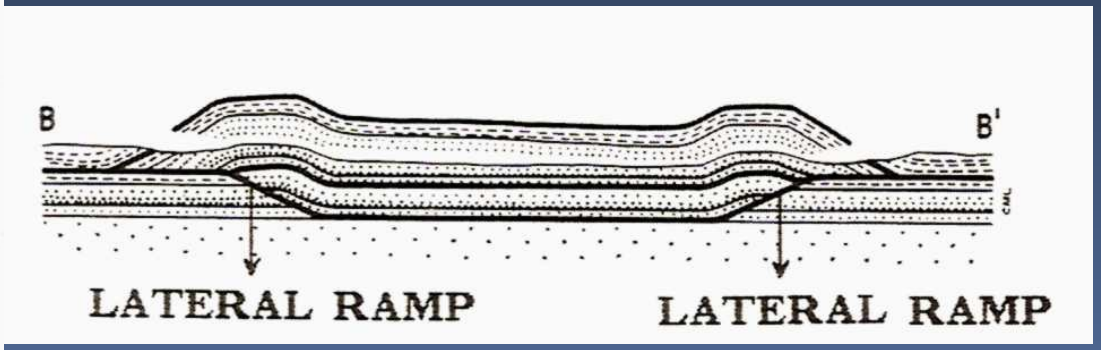
Gries and Dyer (RMAG & DGS, 1985)

Tectônica de pele fina – *thin-skinned tectonics (dois níveis de superfícies de descolamento)*

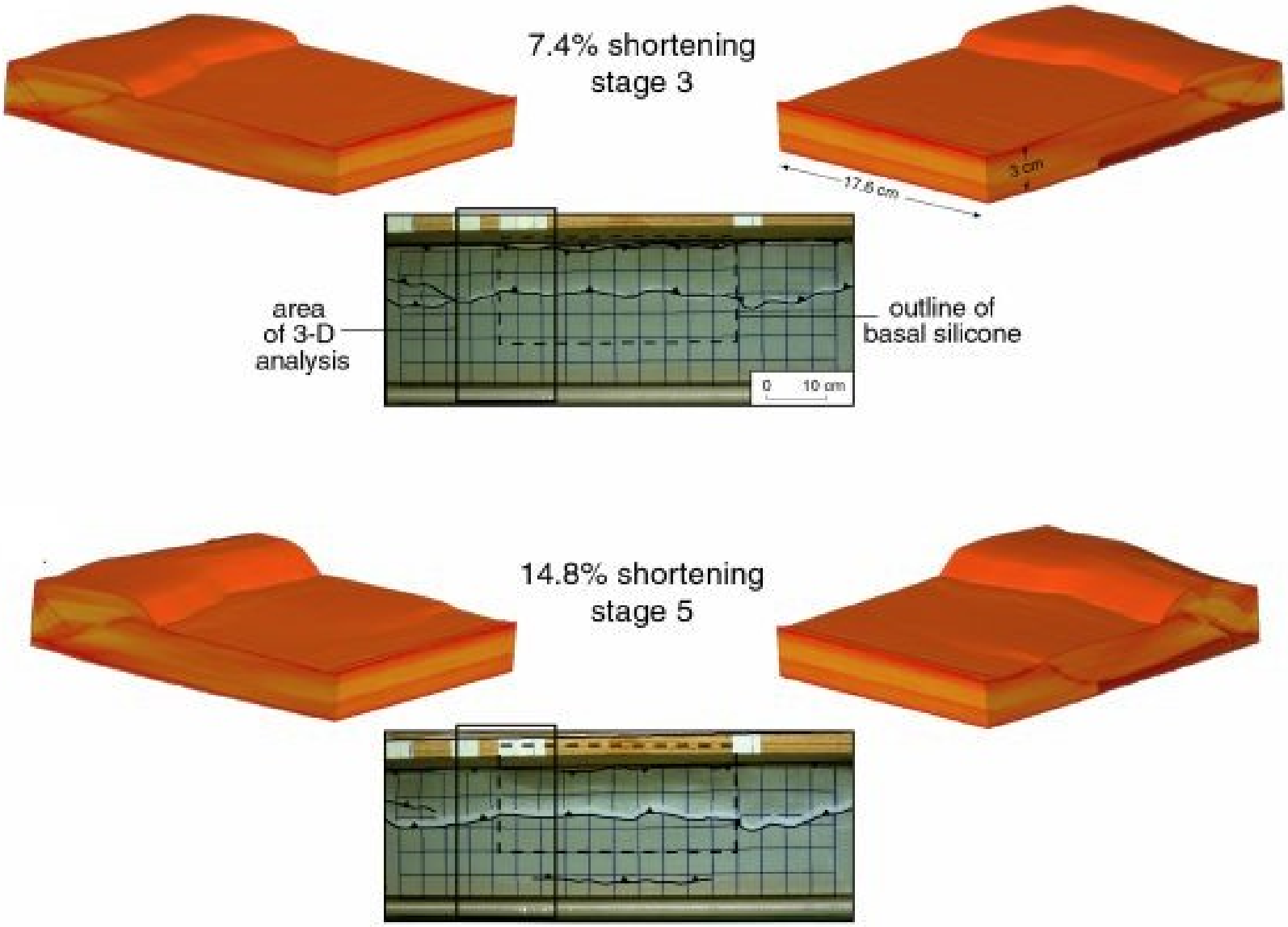
Duplexes – visão em perfis ortogonal (A-A´) e paralelo (B-B´) a direção das falhas



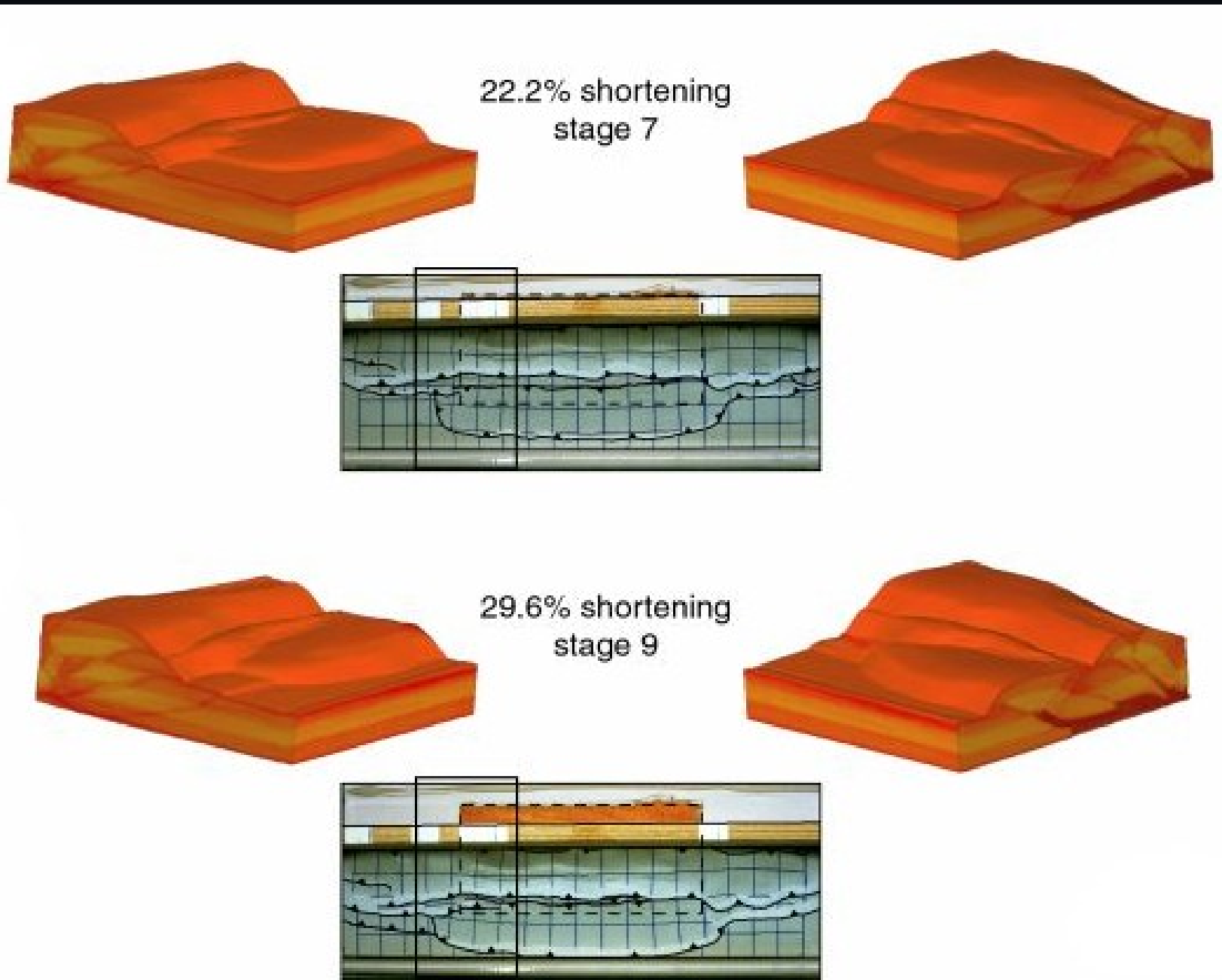




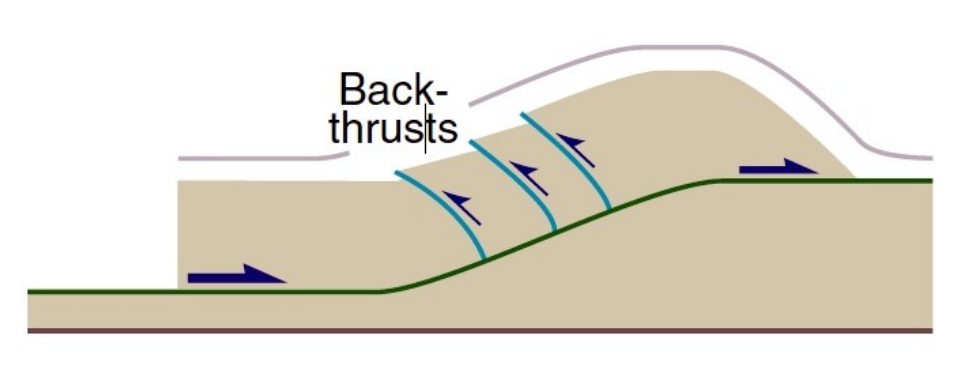
Formação de duplexes em modelo físico ou análogo

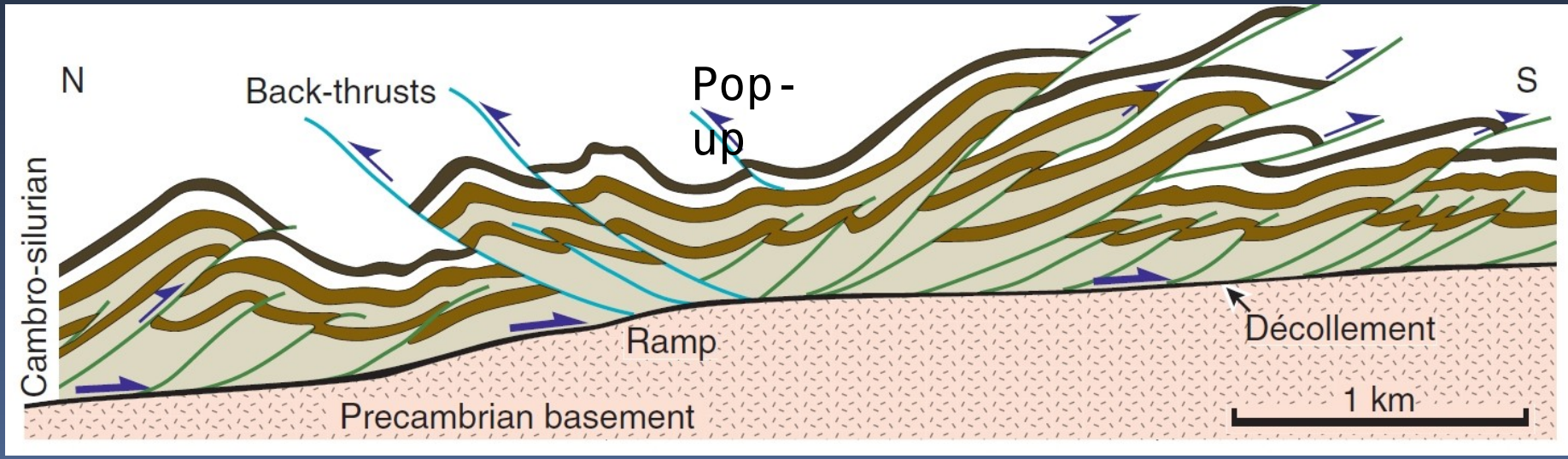


Formação de duplexes em modelo físico ou análogo



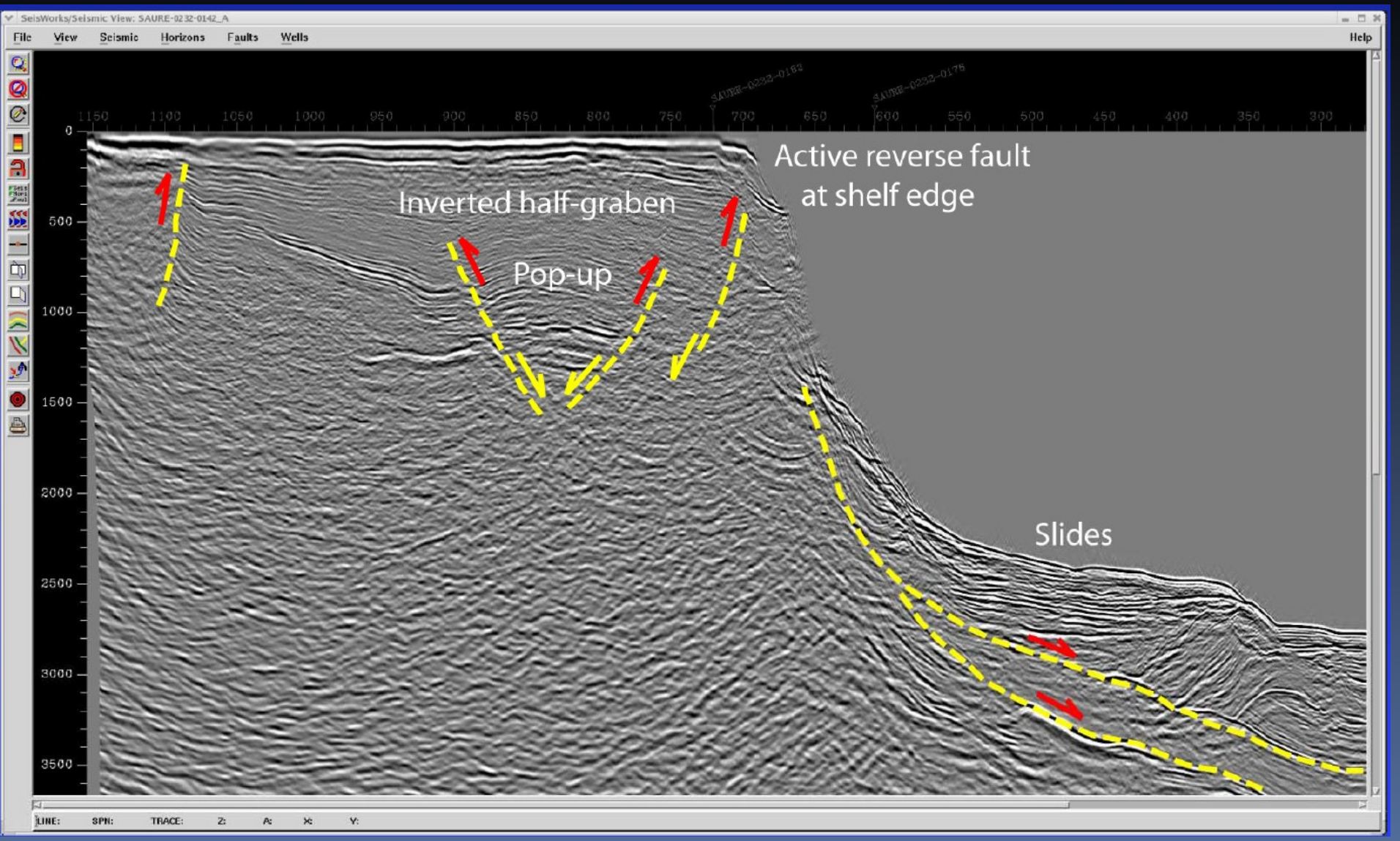
Retrocavalgamentos(*back-thrusts*), *Pop-Ups* e *tectônica de Pele Fina (Thin-skinned)*





Retrocavalgamentos nucleados na variação do ângulo de mergulho de um plano de falha ou de uma superfície de descolamento.

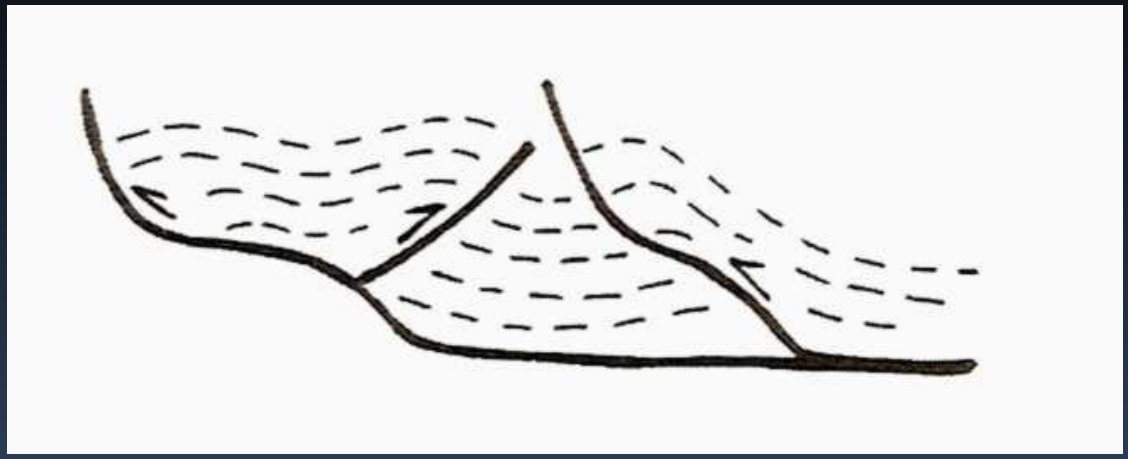
Arranjo geométrico entre falhas reversas – formação de *POP-UP*

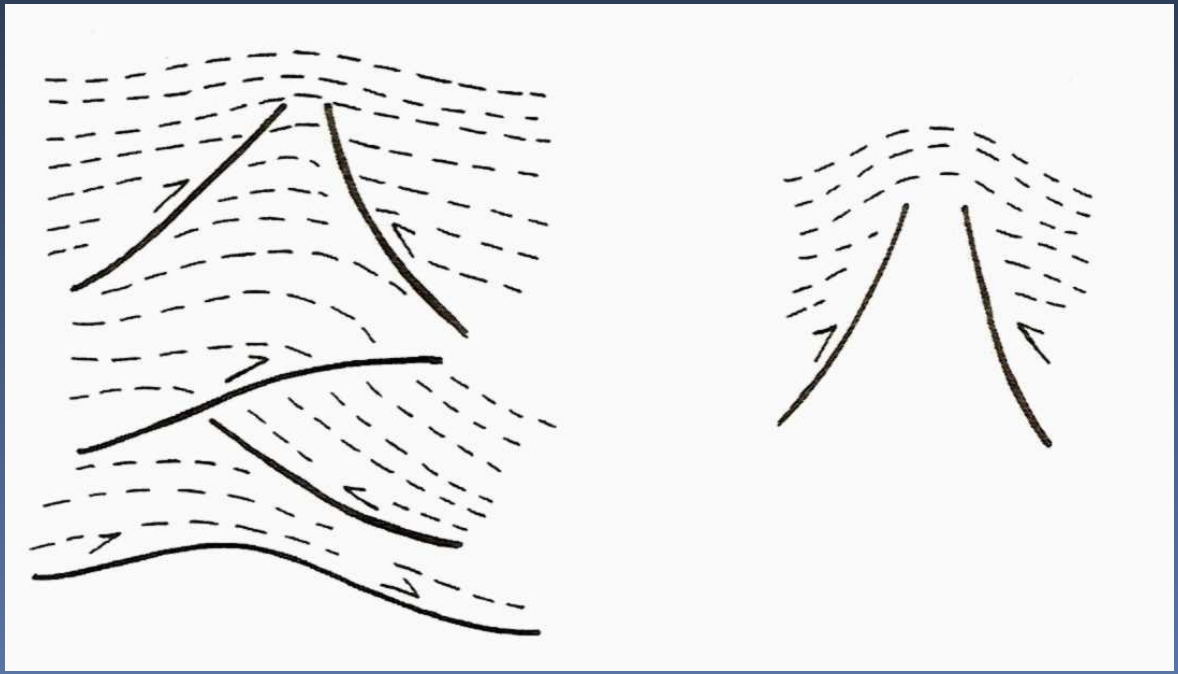


Empurrão e retro empurrão gerando bloco levantado, constituindo um *POP-UP. Bacia de Sergipe – Alagoas. Pop – up* gerado por inversão de falha

Arranjo geométrico entre falhas reversas – vistas em perfil geológico ou em linha sísmica

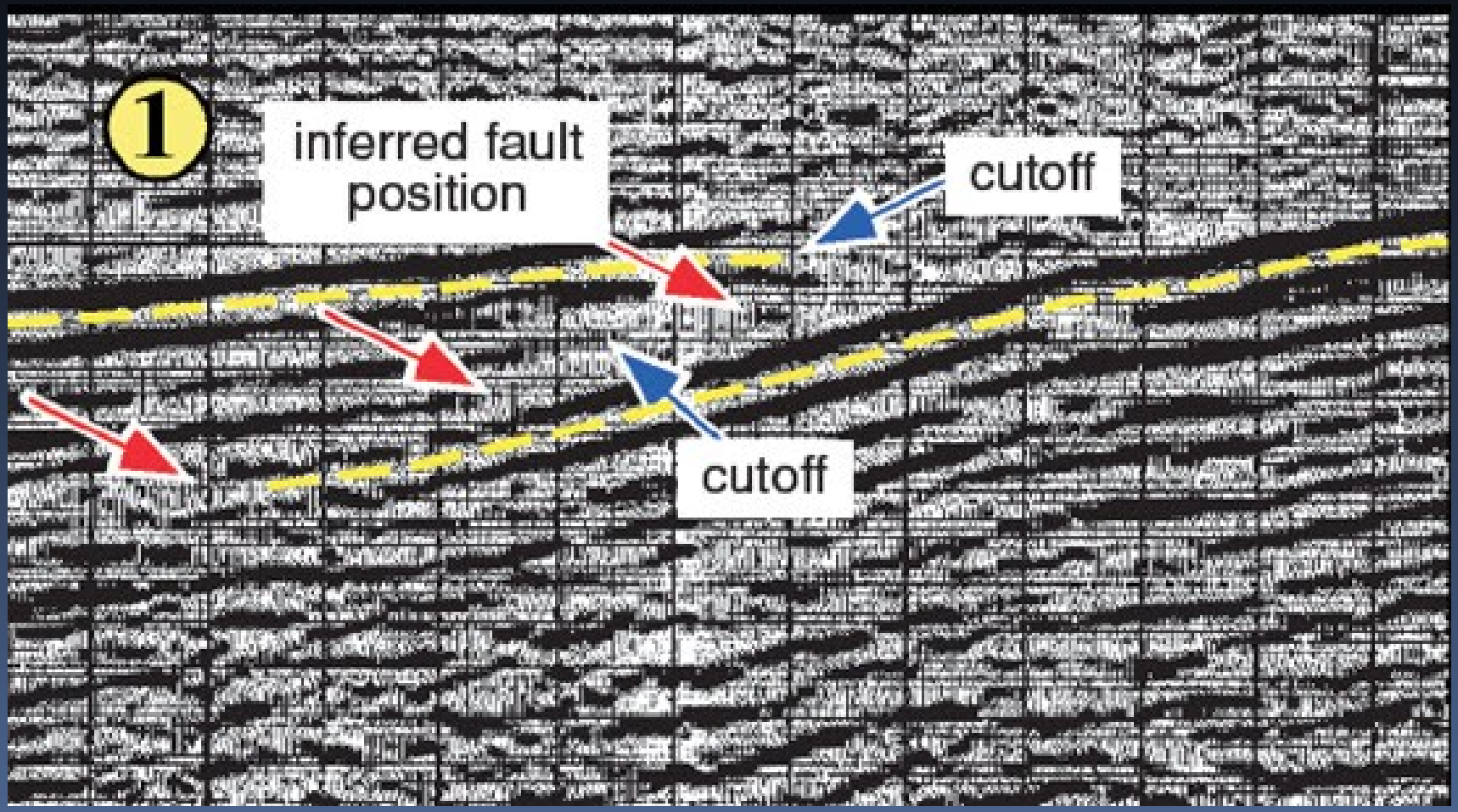
Empurrão, retro empurrão e feição triangular formada por falhas reversas





Arranjos com feições triangulares formadas por falhas reversas. Notar dobras associadas

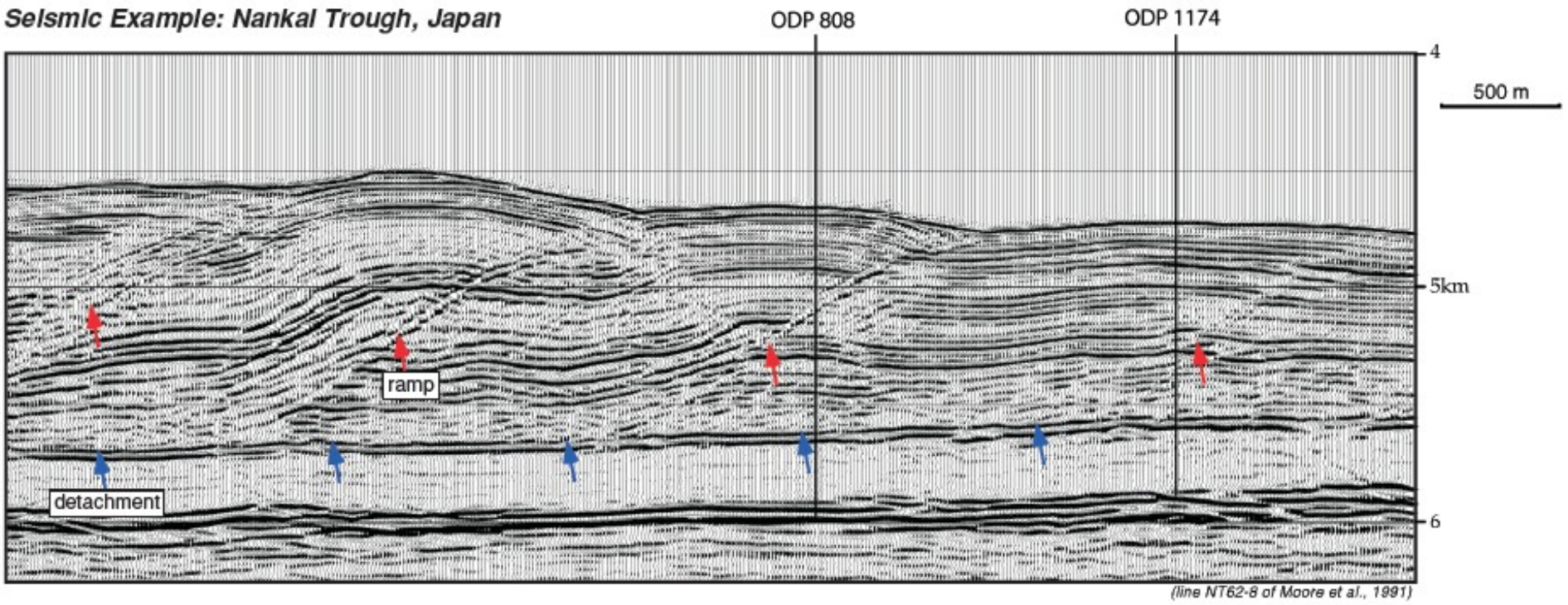
Reconhecimento das falhas de empurrão em linhas sísmicas nem sempre é fácil



Refletores com terminações interrompidas e duplicados

Superfície de descolamento → tectônica de pele fina - *thin-skinned tectonics* (tectônica que não envolve o embasamento, apenas a cobertura sedimentar)

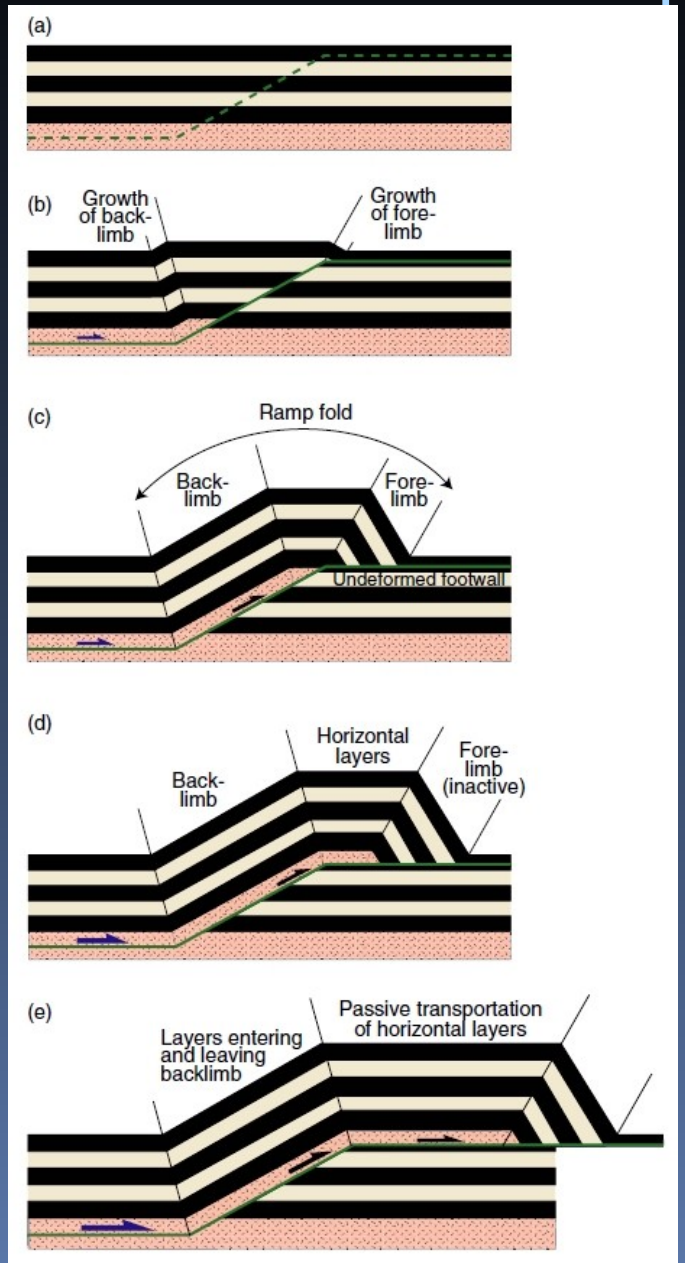
Recognizing detachments



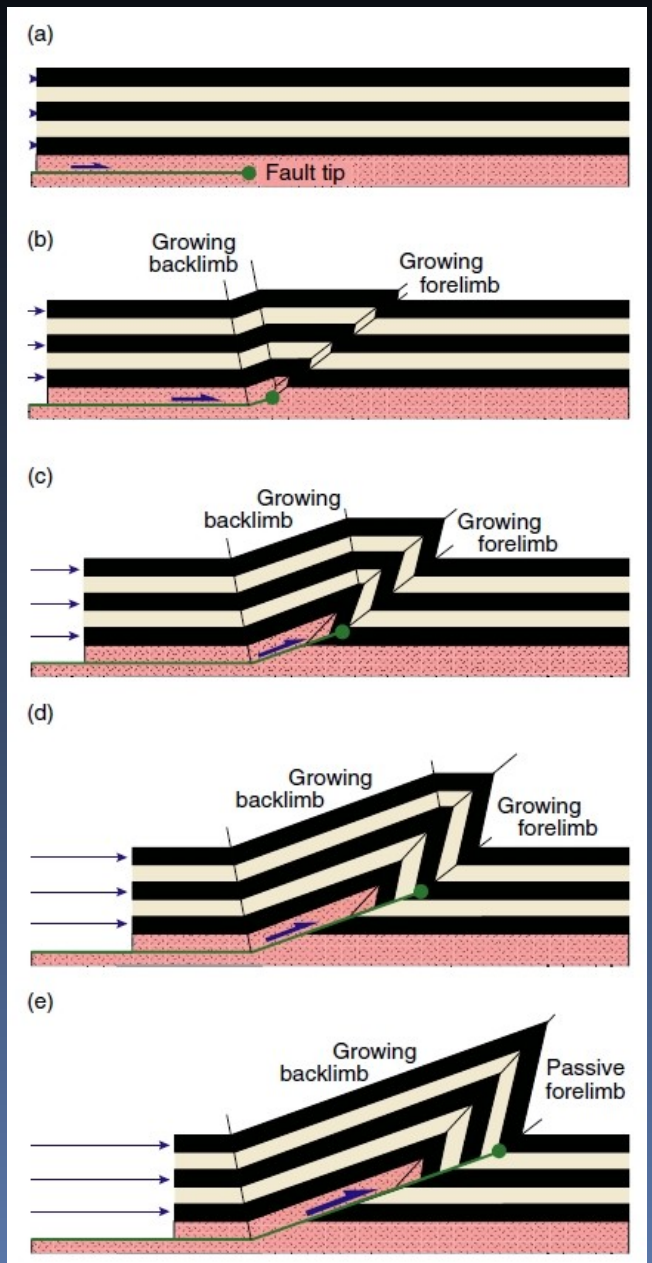
Seismic Interpretation of Contractional Fault-Related Folds
An AAPG Seismic Atlas

Dobras associadas a falhas de empurrão

Fault-bend fold

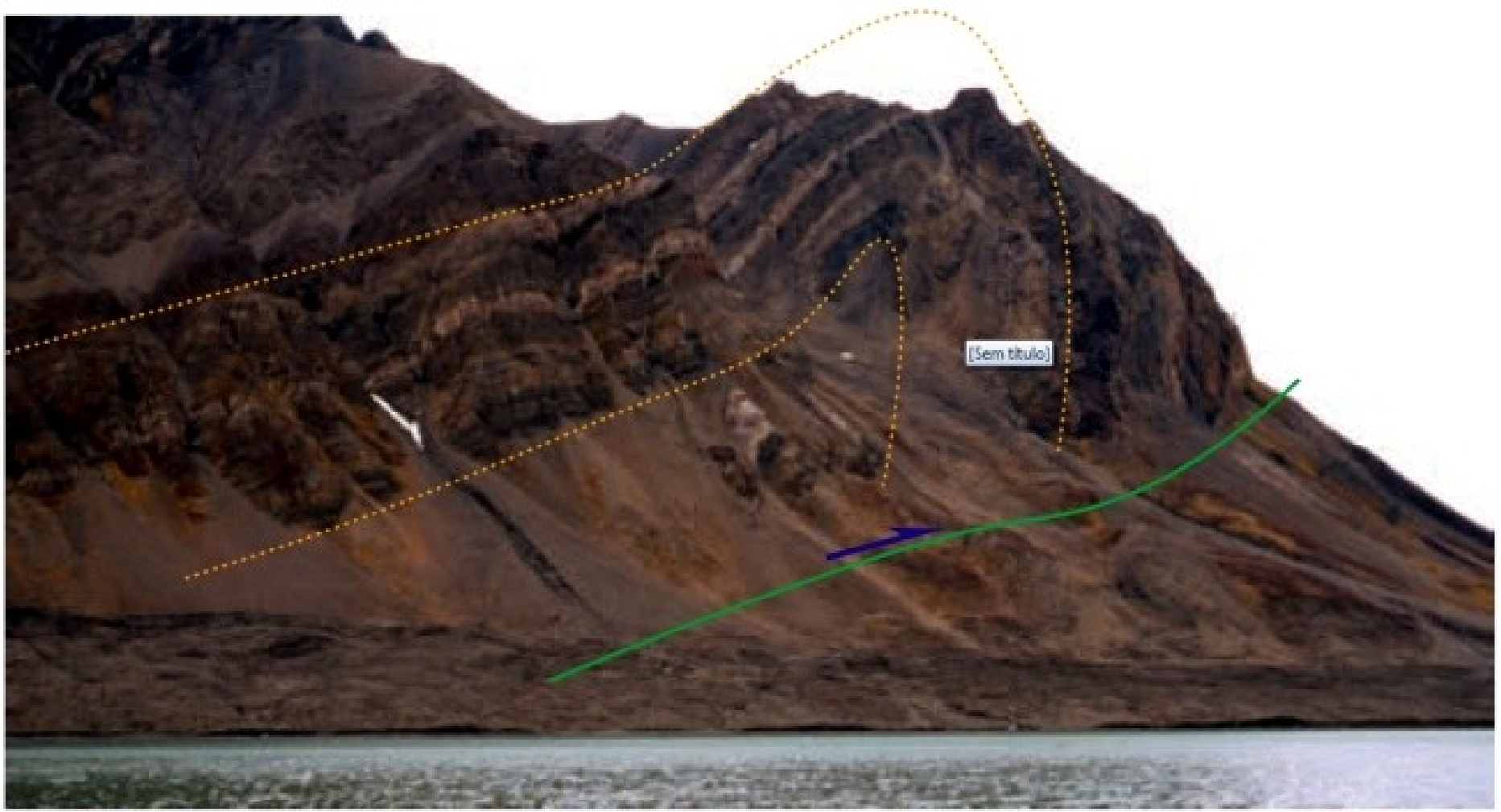


Fault-propagation fold –"dobras forçadas"

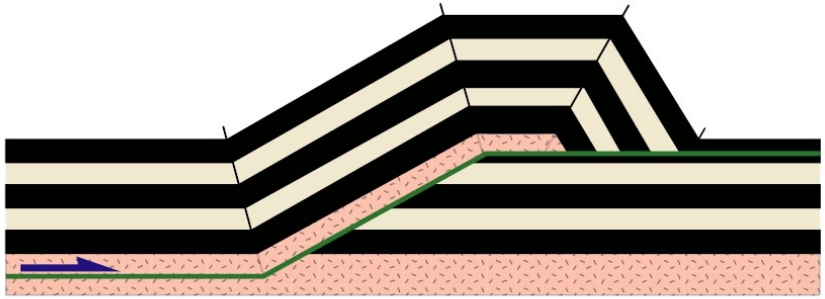


Dobras associadas a falhas de empurrão

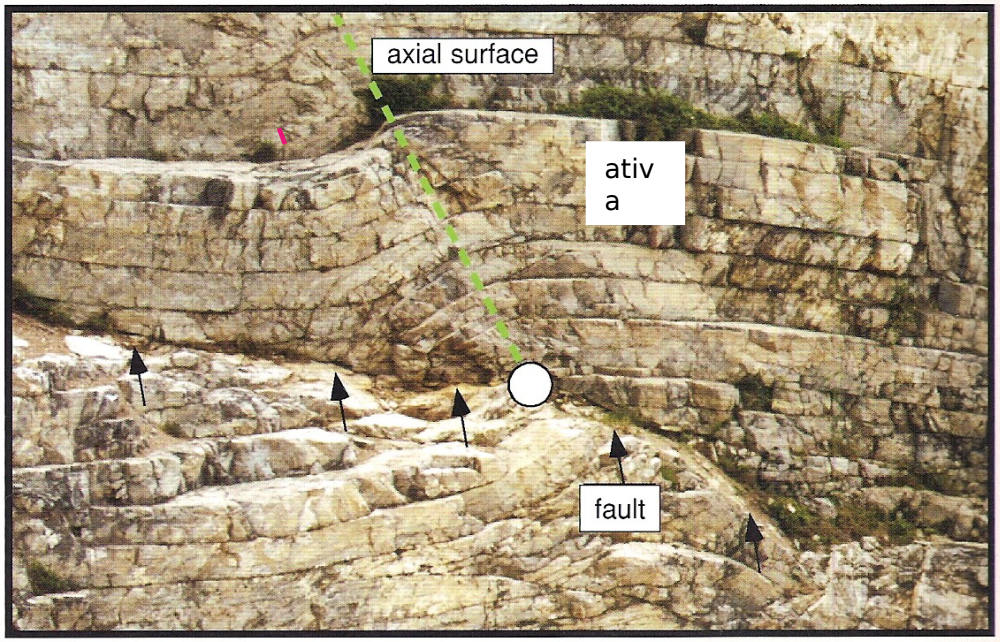
Fault-bend fold



Dobras associadas a falhas de empurrão

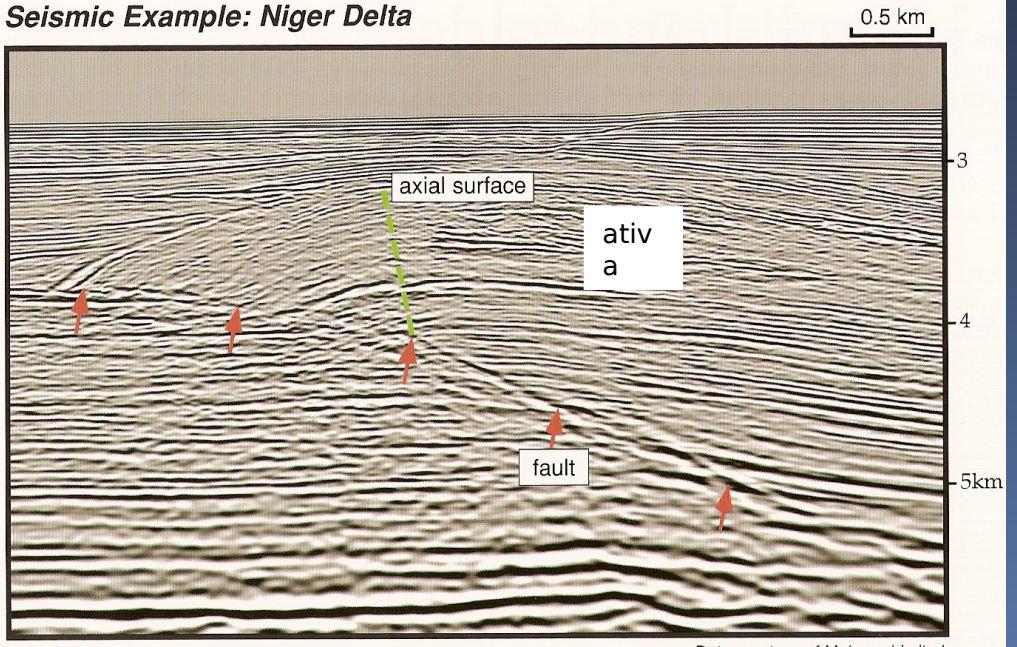


Field Example



Crows Nest Pass, Alberta, Canada. (JHS/FDB)

Seismic Example: Niger Delta

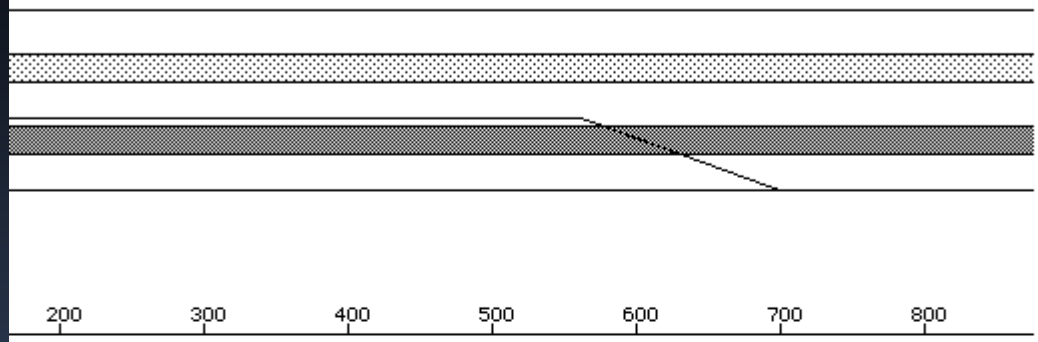


Data courtesy of Mabone Limited

Duplex - The Movie

by Rick Allmendinger © 1990

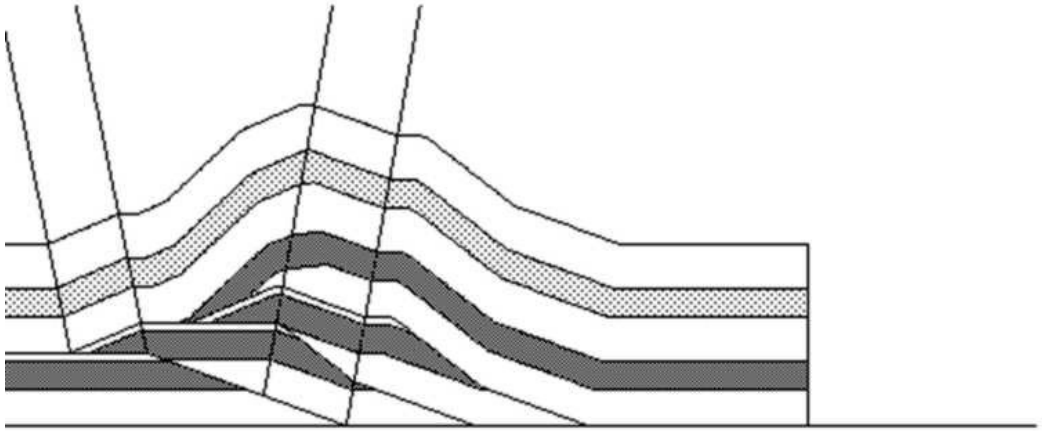
individual frames were produced by
MacThrustRamp™



☐ Go Backwards
☐ Slow motion

Show Movie

click the mouse to stop the movie

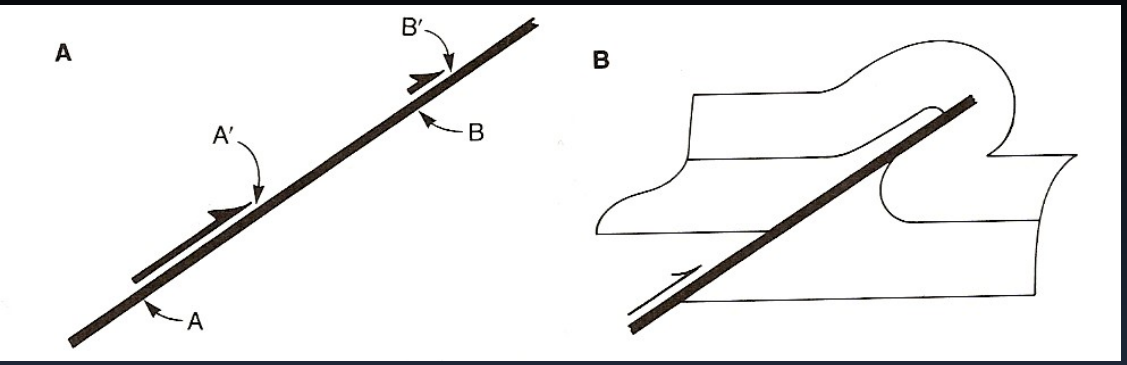


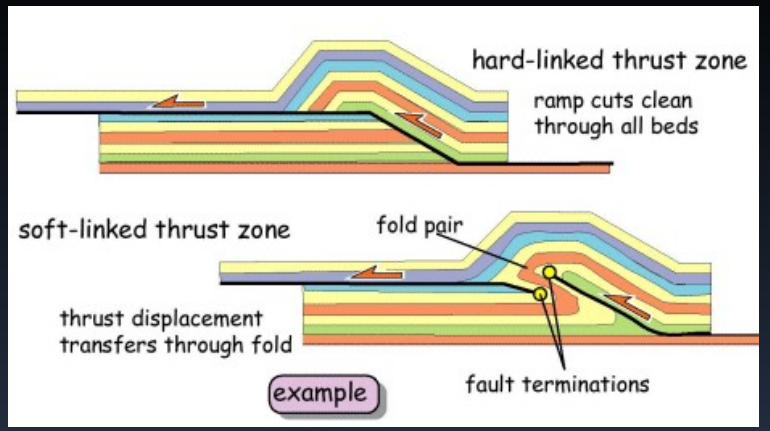
☐ Go Backwards
☐ Slow motion

Continue

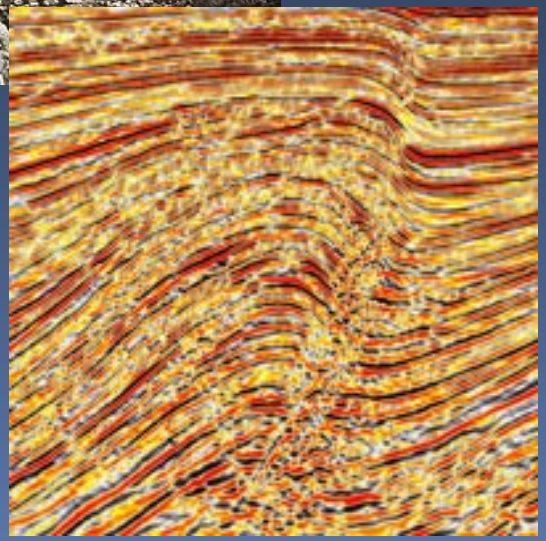
click the mouse to stop the movie

Terminação de falhas de empurrão

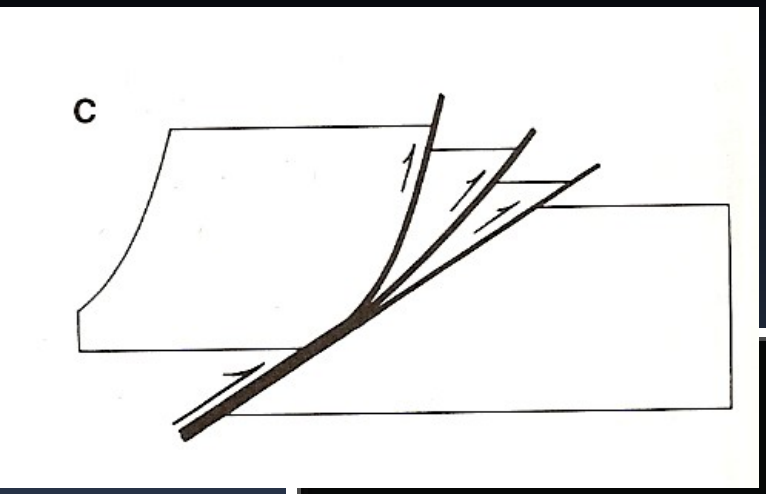




Dobras forçadas

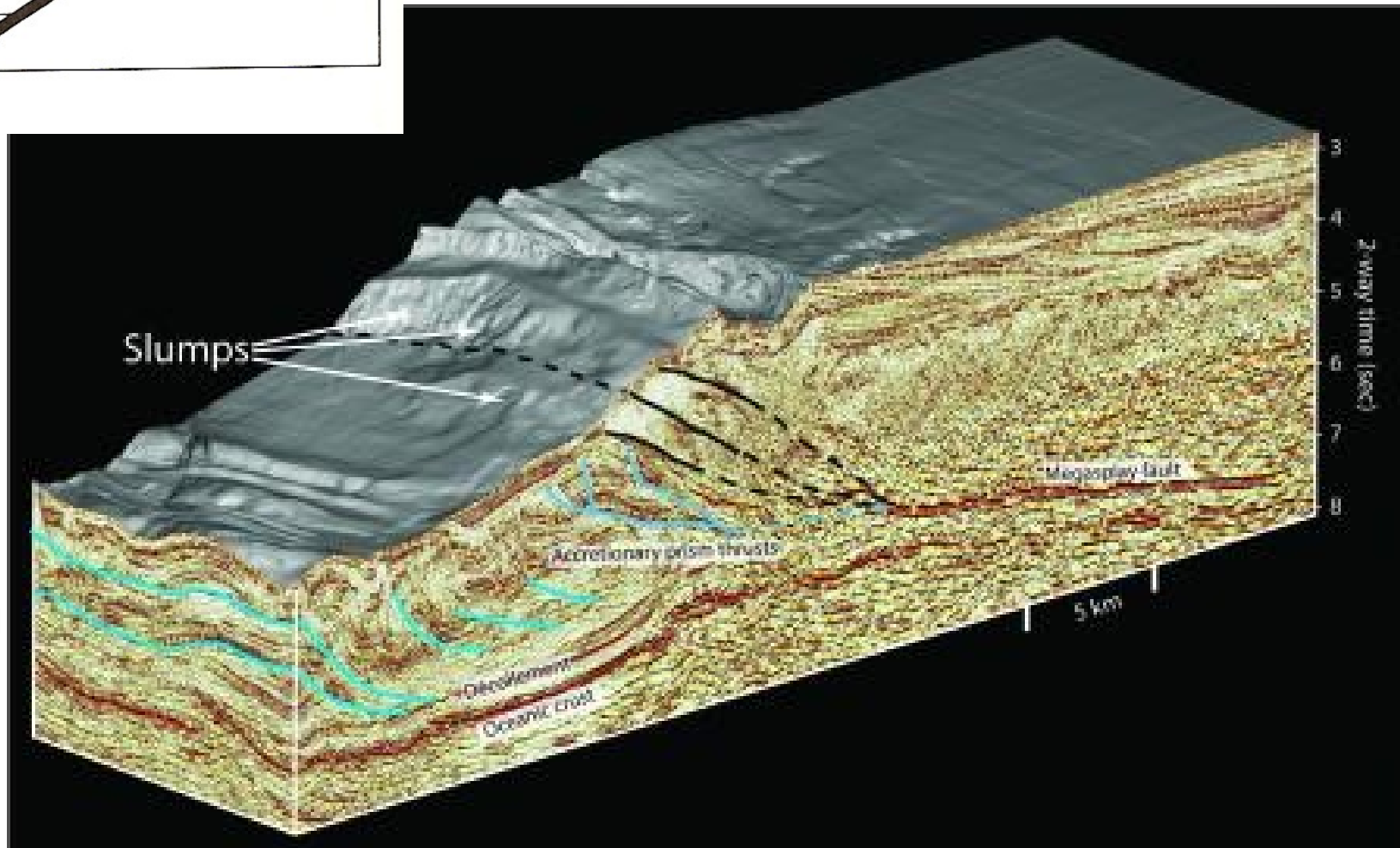


Terminação de falhas de empurrão

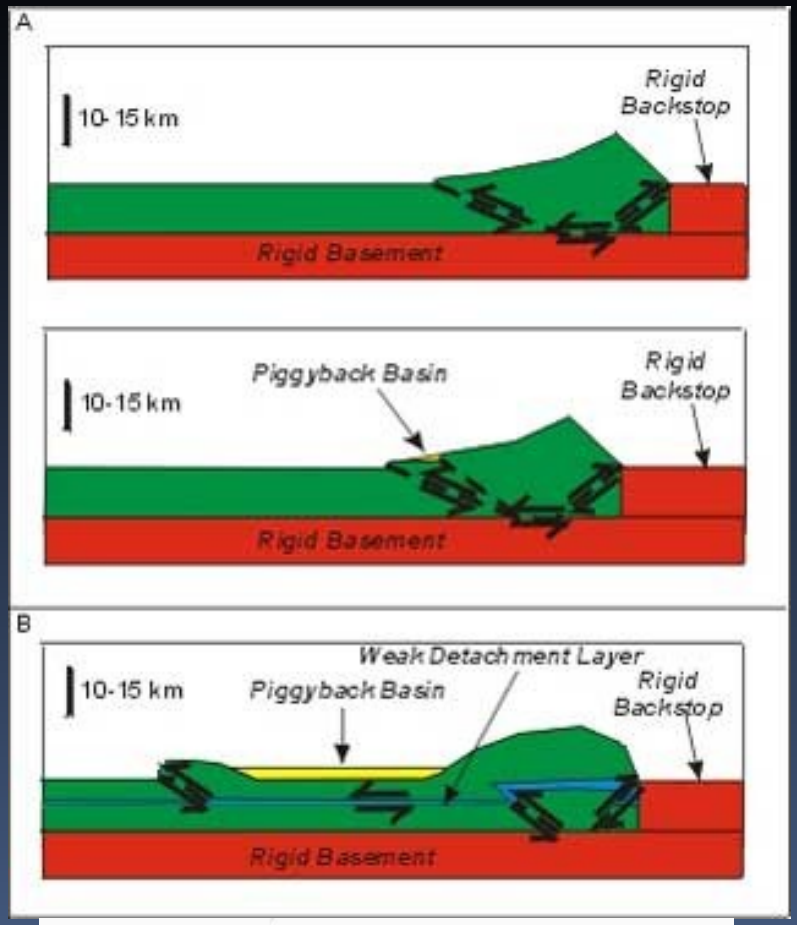


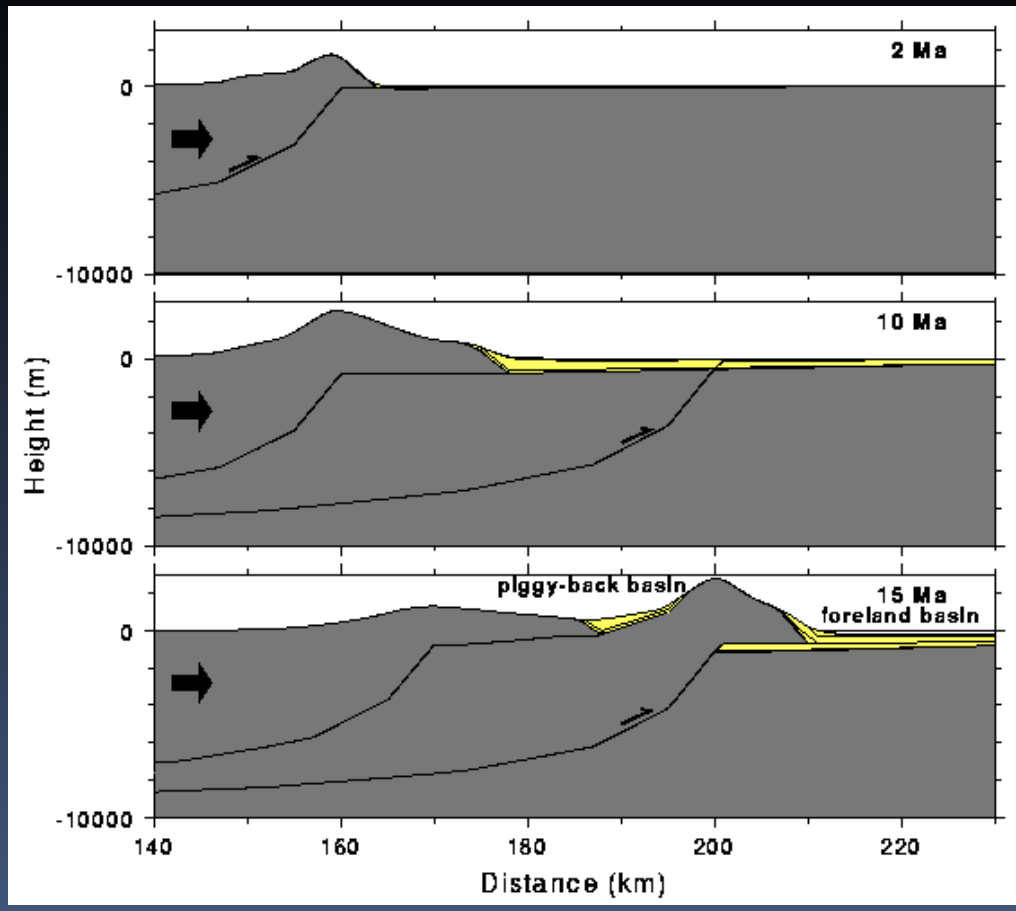
Ramificação de falhas de empurrão

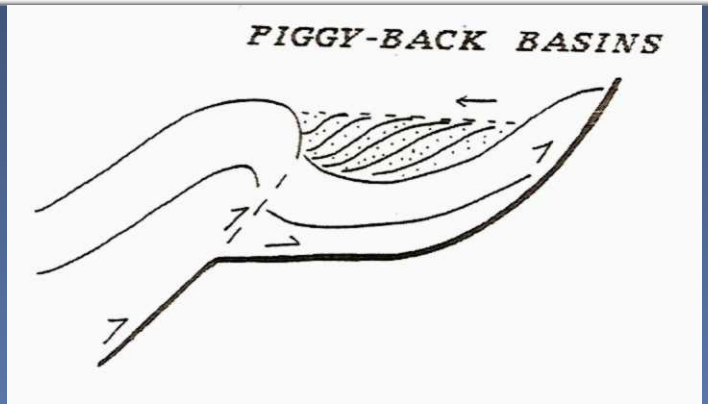
– *splay faults ou* leque embricado



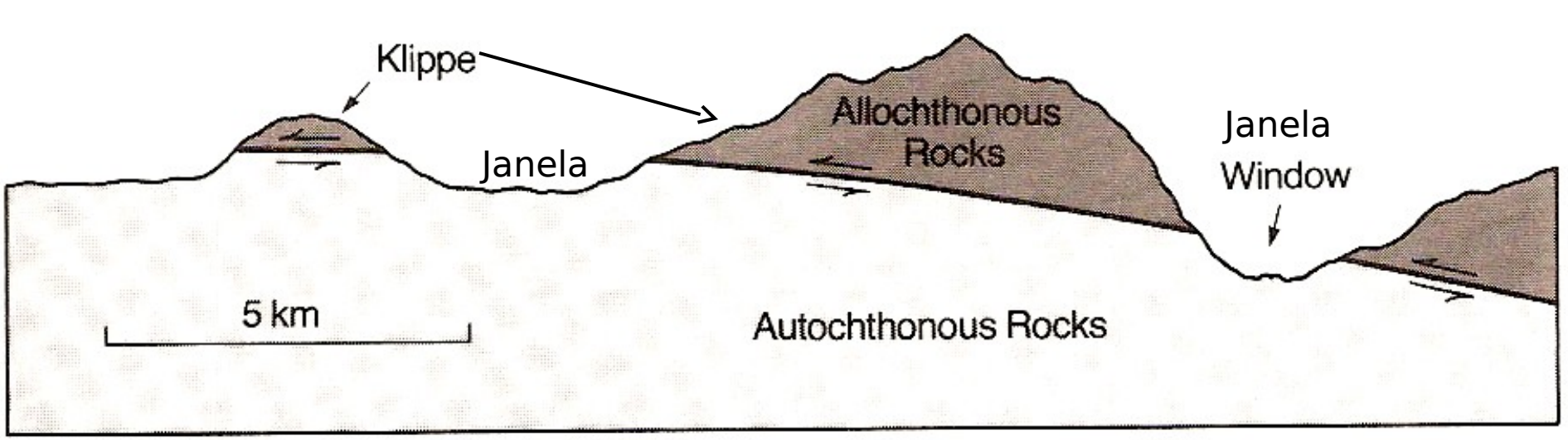
Desenvolvimento de bacias *piggy-back* sobre superfície de descolamento (Wesley Groome 2008) e associada a bacia de ante-país (foreland)



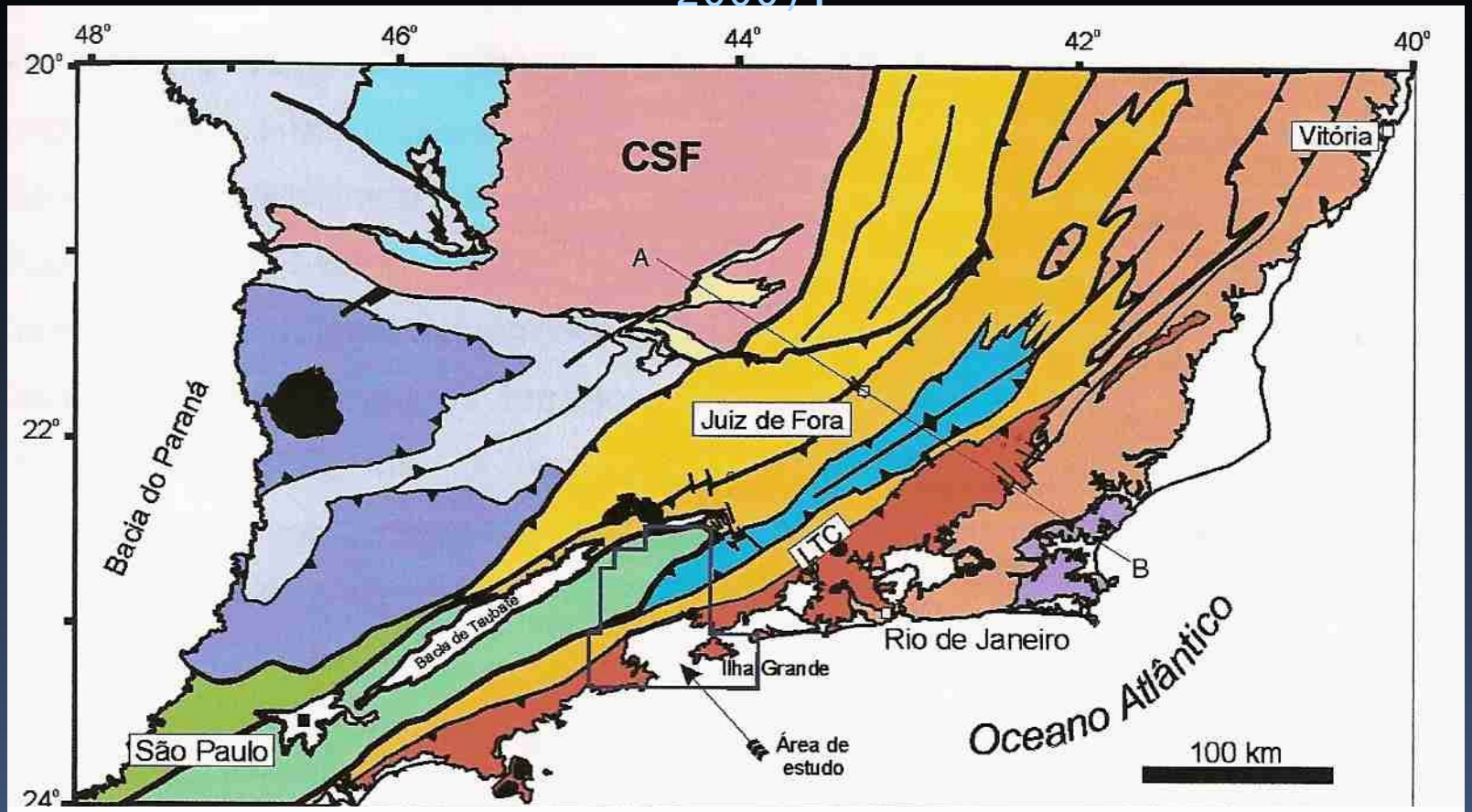


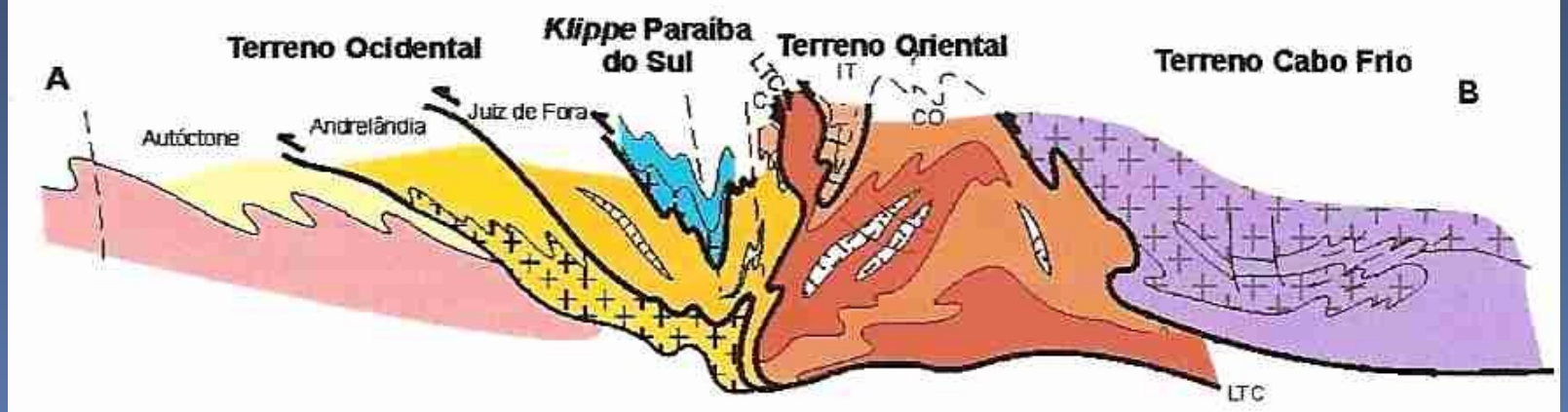


Feições relacionadas a processos erosivos em rochas alóctones devido a empurrões regionais

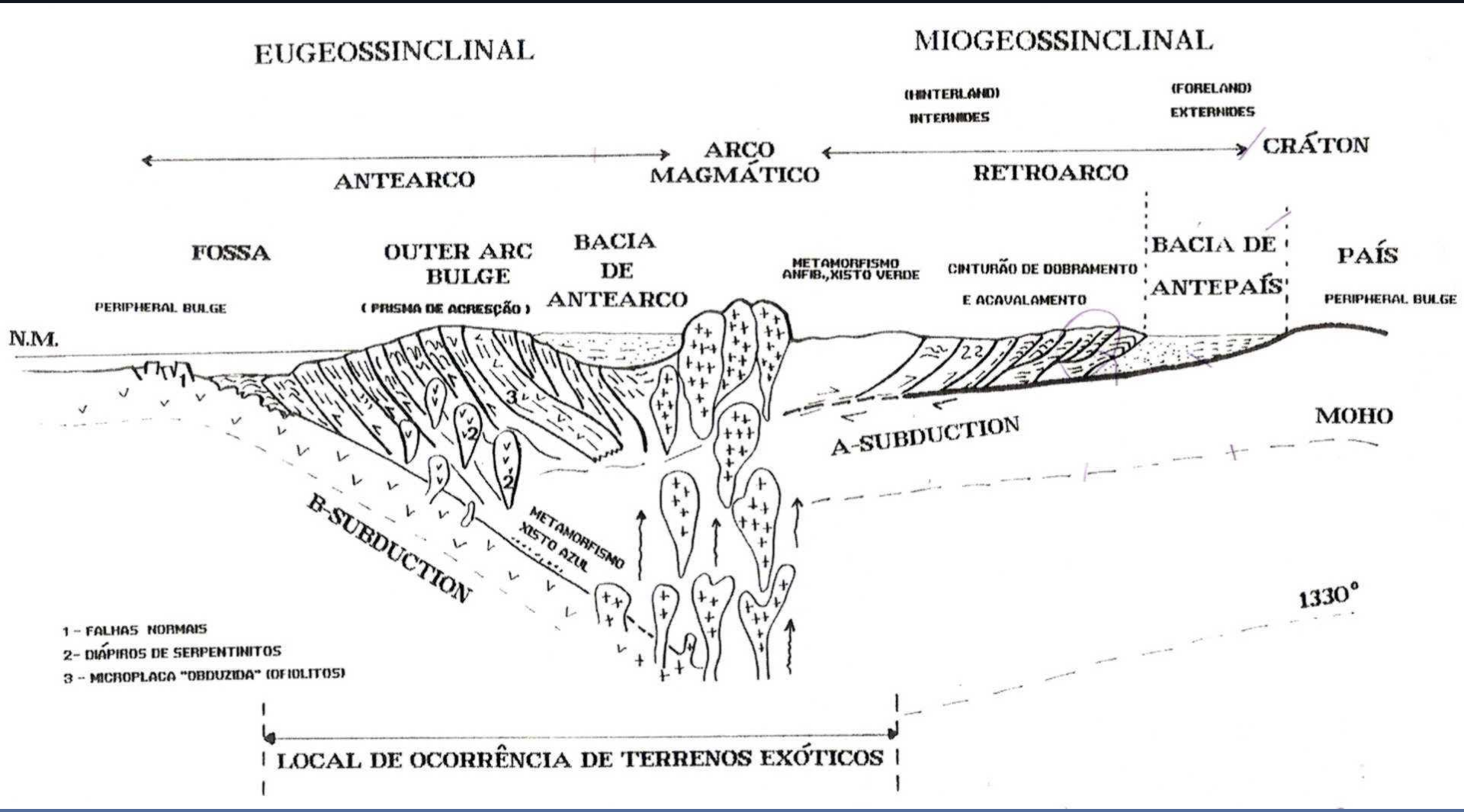


Mapa geológico e perfil do Cinturão Ribeira (Heilbron *et al.* 2000).

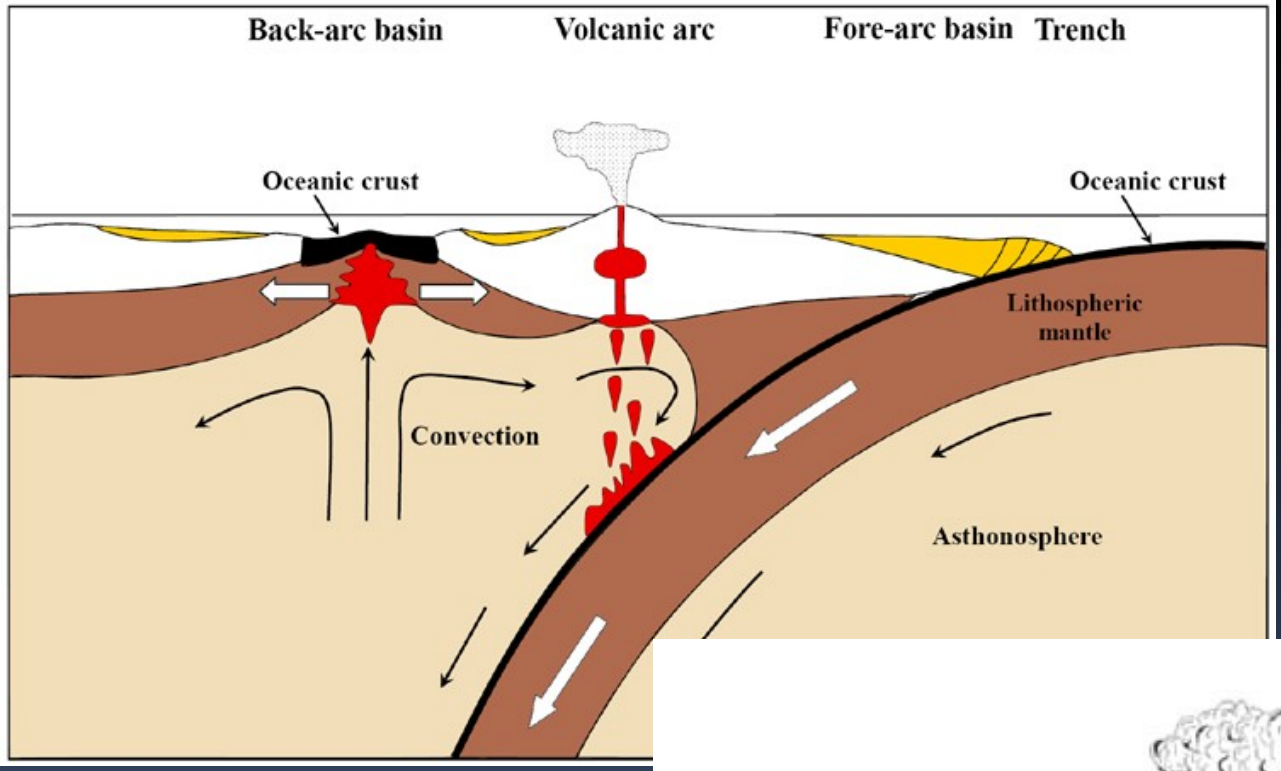




Ambiente compressivo – margem convergente



Ambiente compressivo – margem convergente



Bacia Back-arc (acima)

Bacia Intra-arc (ao lado)

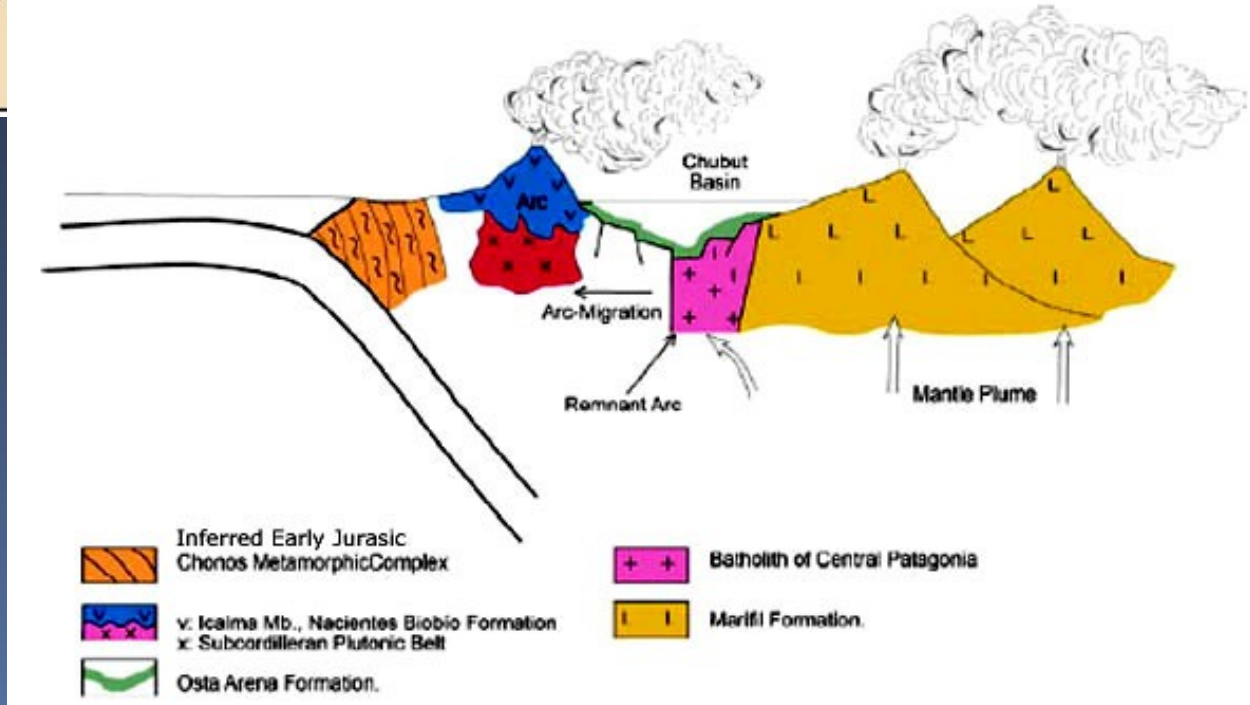
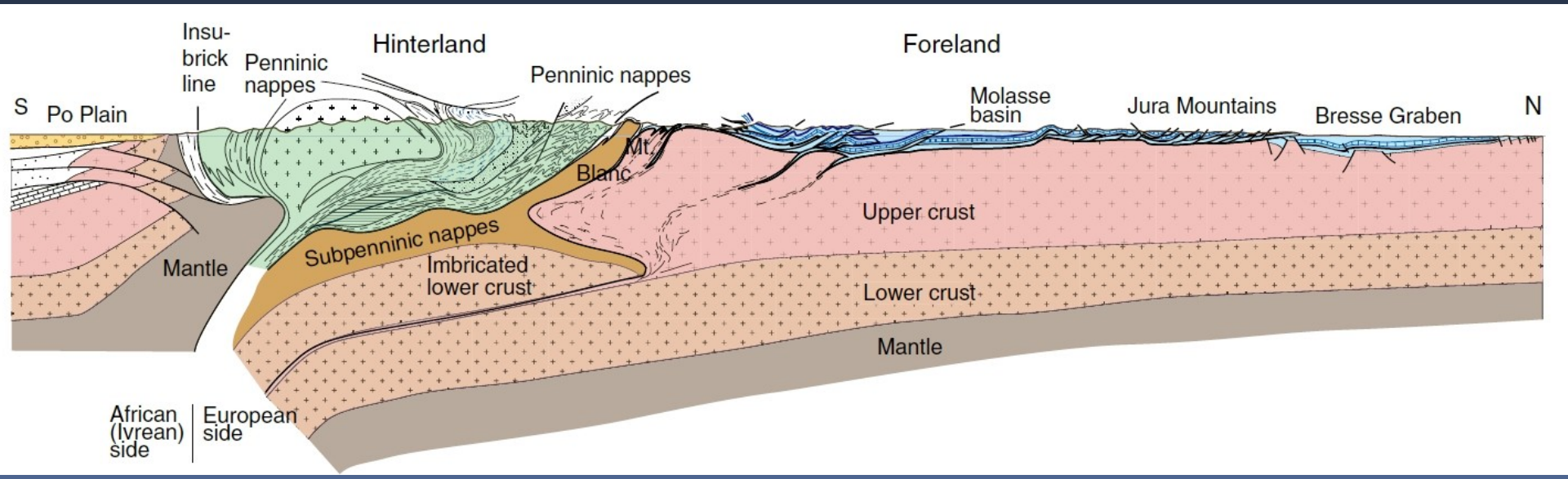


FIG. 7. Schematic interpretative tectonic setting of central Patagonia during the Toarcian.

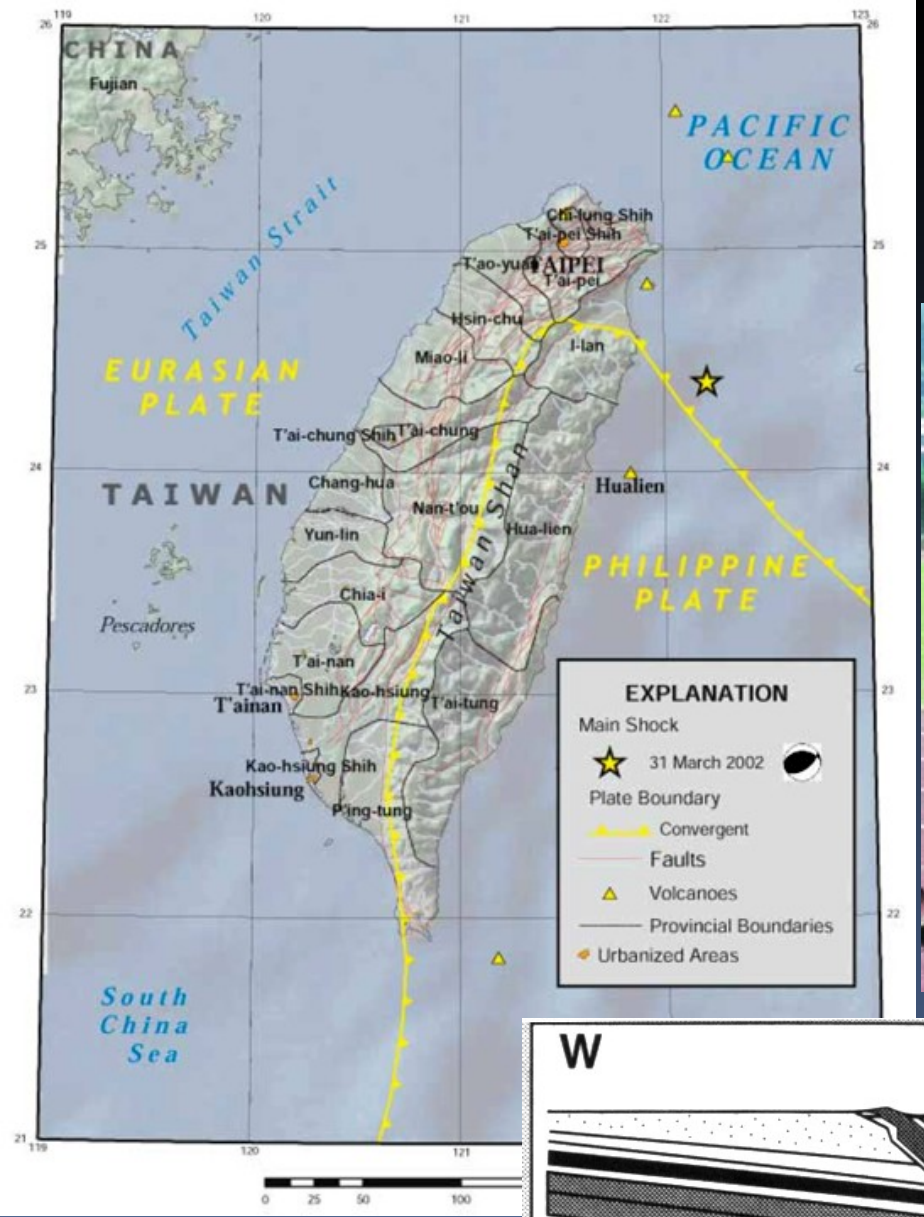
Ambiente Compressivo – Margem Convergente

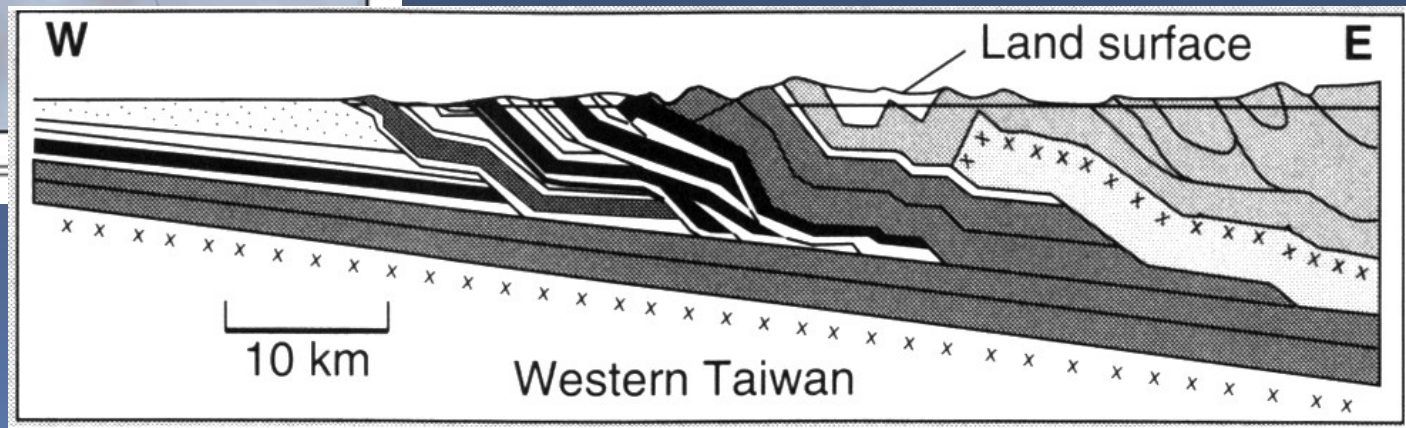
Hinterland - porção central de uma orogênese. Em geral, coincidente com o arco magmático.

Foreland – porções periféricas, em direção à plataforma ou cráton.

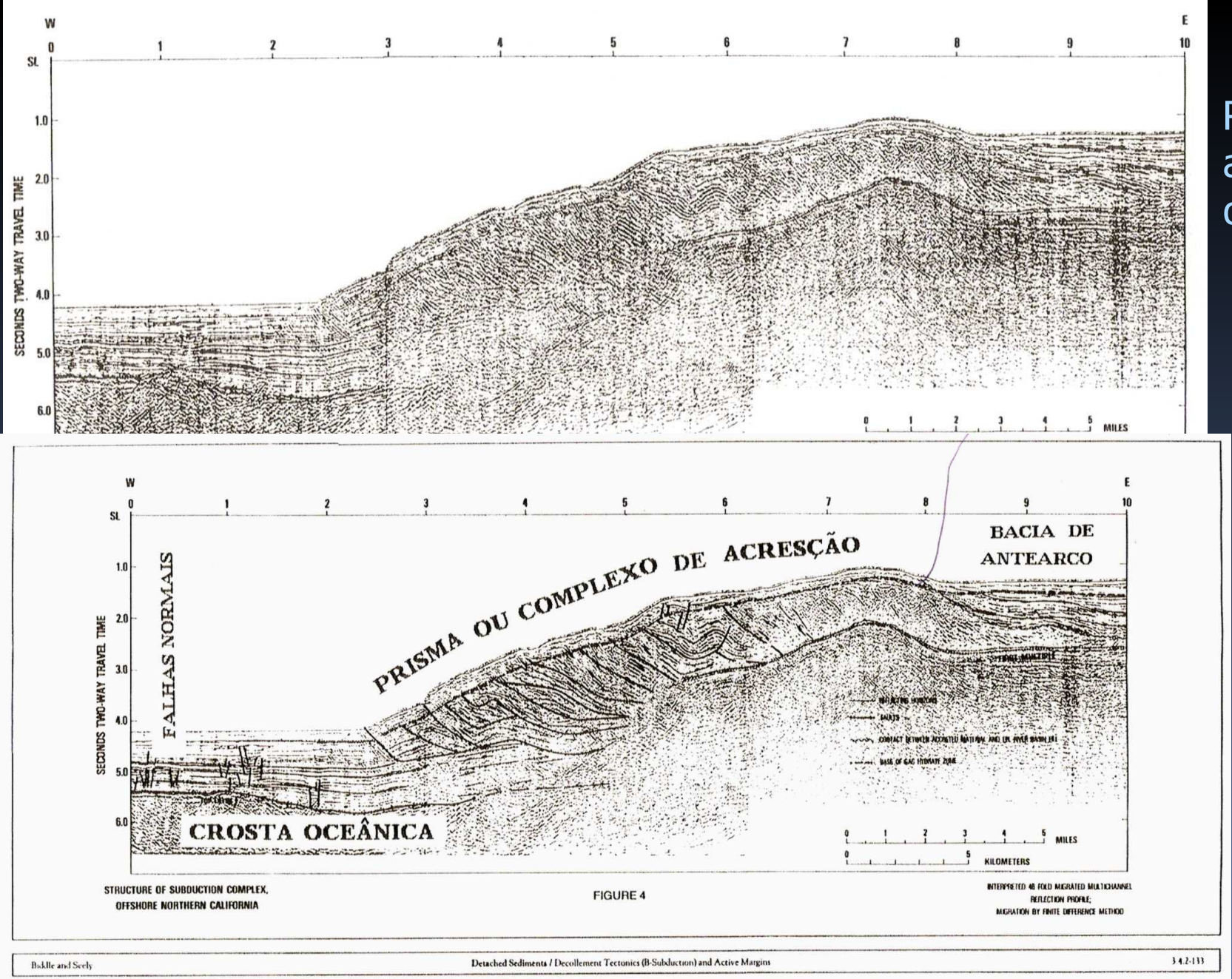


Ambiente compressivo – prisma acrescionário





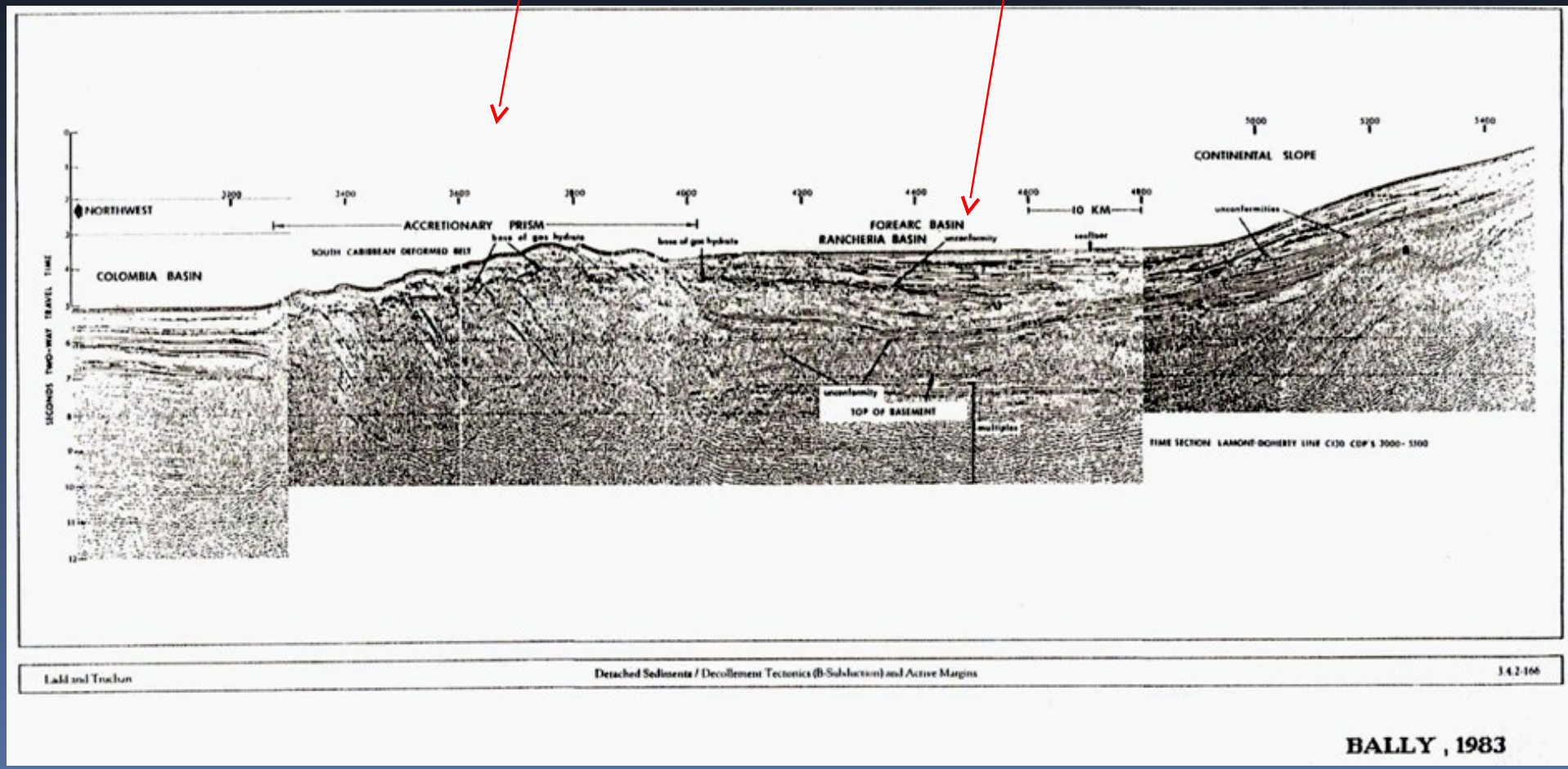
Prisma acresci o-nário



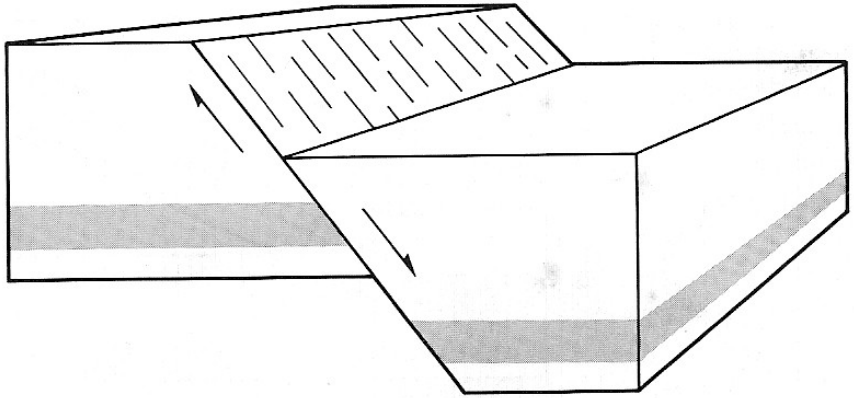
CALIFORNIA / OREGON

BALLY , 1983

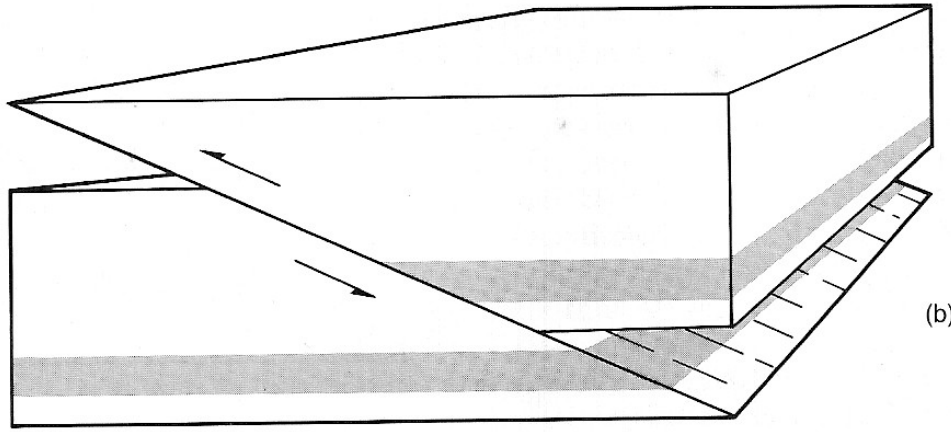
Prisma acrescionário e bacia de ante-arco



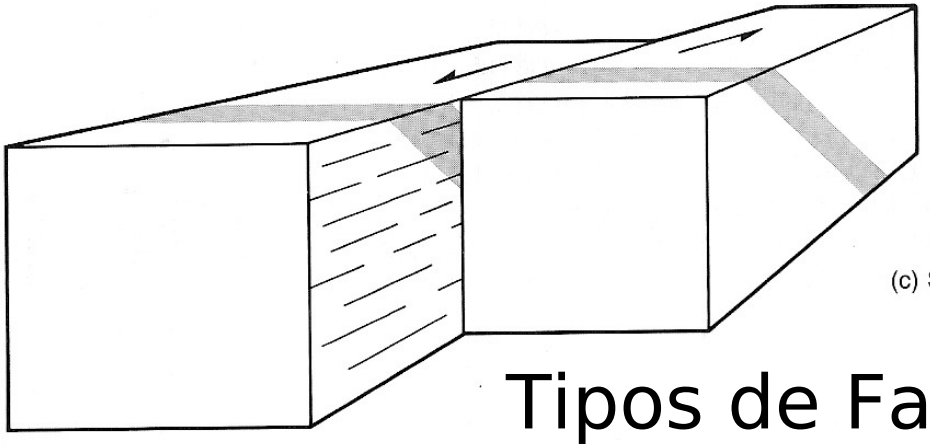
BALLY , 1983

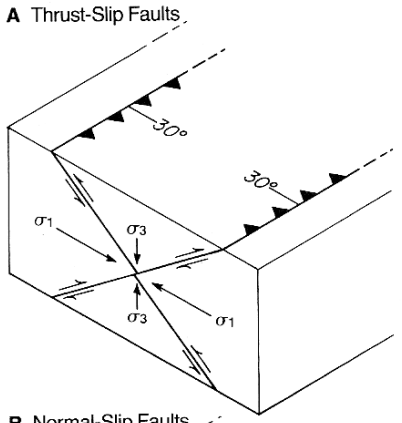
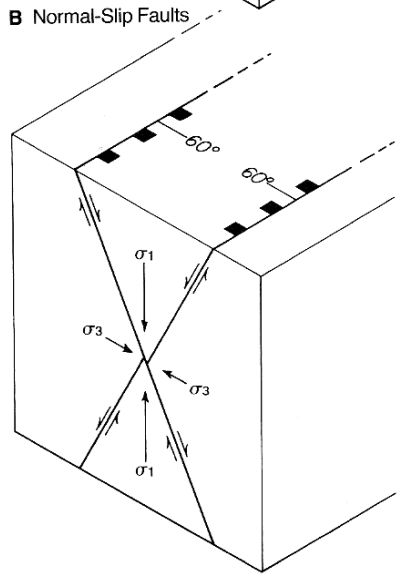
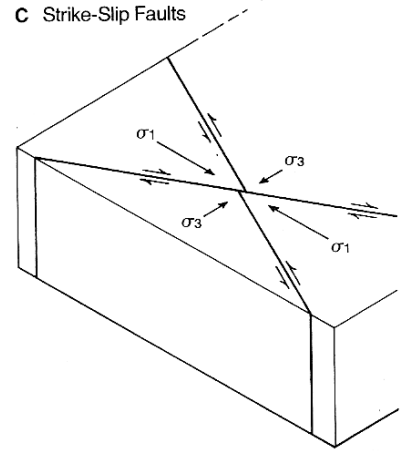


(a) Normal fault



(b) Thrust fault



(c) Strike-slip fault

Tipos de Falhas